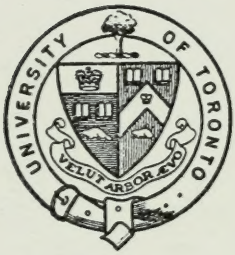

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OPHTHALMOLOGICAL TRANSACTIONS

VOL. XVIII

TRANSACTIONS

OF THE

OPHTHALMOLOGICAL SOCIETY

OF THE

UNITED KINGDOM

VOL. XVIII

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LONDON
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1898

TRANSACTIONS

OF THE

OPHTHALMOLOGICAL SOCIETY

OF THE

UNITED KINGDOM

VOL. XVIII

SESSION 1897-8

WITH

LIST OF OFFICERS, MEMBERS, ETC.

LONDON
J. & A. CHURCHILL
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Transactions of the American Ophthalmological Society.

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The Society does not hold itself responsible for the statements, reasonings, or opinions expressed in the communications which the Council has deemed suitable for publication.

11, Chandos Street,
Cavendish Square, W.

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L.—Librarian.
S.—Secretary.
C.—Member of Council.
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†.—Denotes Non-Resident Life Members.

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O.M. *Abercrombie, John, M.D. (T.), 23, Upper Wimpole Street, W. (S. 1882-5. C. 1885-8. V.-P. 1897-8.)

1884 †Allison, H., M.D., care of Messrs. Binny and Co., Madras, India.

1887 *Anderson, Tempest, M.D., 17, Stone-gate, York.

1883 Andrews, A. G., Carlton House, Moss Lane East, Manchester.

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ELECTED

1891 †Armstrong, Hugh, Hobart, Tasmania.

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O.M. *Barlow, Thomas, M.D., 10, Wimpole Street, W. (C. 1880-81. V.-P. 1894-7.)

1889 †Barrett, James W., M.D., 34, Collins Street East, Melbourne, Australia.

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1892 Bass, Frederick, 9, Upper Wimpole Street, W.

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1888 *Beaumont, W. M., 4, Gay Street, Bath.

O.M. *Beevor, C. E., M.D., 33, Harley Street, W. (S. 1891-4. C. 1894-7.)

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1897 Bennett, H. Percy, 8, St Mary's Place, Newcastle-on-Tyne.

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O.M. Berry, G. A., M.D., 31, Drumsheugh Gardens, Edinburgh. (C. 1889-92. V.-P. 1895-8.)

1881 *Bickerton, T. H., 88, Rodney Street, Liverpool. (C. 1895-8.)

1892 Black, John Wilson, M.D.Edin., 46, Academy Street, Inverness.

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ELECTED

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1897 Breuer, August, M.D., 10, Finsbury Circus, E.C.

1891 Bristowe, Hubert Carpenter, M.D., Wrington, Somerset.

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1898 Browne, James M., M.B., Royal Eye Hospital, Southwark, S.E.

1895 Browne, J. W., M.D., 10, College Square North, Belfast.

1893 †Bull, G. J., M.D., 4, Rue de la Paix, Paris.

1889 Bullar, John F., M.B., 7, Carlton Crescent, Southampton.

1883 †Buller, Frank, M.D., 838, Dorchester Street, Montreal, Canada.

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O.M. Buzzard, Thomas, M.D., 74, Grosvenor Street, W. (V.-P. 1888-91. C. 1881-2.)

1897 Byers, W. Gordon M., M.D., Moorfields Eye Hospital, E.C.

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1891 Campbell, E. Kenneth, M.B., 28, Wimpole Street, W.

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1891 Cargill, L. Vernon, 15, Stratford Place, W.

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ELECTED

1888 Channer, C. H., M.B., Surgeon-Major; Belgaum, Bombay.

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1898 Chatterton, Edgar, 16, Hillmarten Road, N.

1885 Chesshire, Arthur Edwin, 55, Darlington Street, Wolverhampton.

1897 Chetwood-Aiken, K. C., M.B., C.M., 58, Lemon Street, Truro.

1885 Clarke, Ernest, M.D., B.S., 3, Chandos Street, Cavendish Square, W. (C. 1893-6.)

1885 Collins, E. Treacher (S.), 17, Queen Anne Street, Cavendish Square, W. (C. 1889-92.)

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1898 Cooper, Austin E., M.D., 41, Sloane Square, S.W.

1894 †Coote, Patrick, M.D., 73, St. Ann Street, Quebec, Canada.

1884 Coulter, William, M.D., 2/2, Harrington Street, Calcutta.

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O.M. Cowell, George (V.-P.), 19, Harley Street, Cavendish Square, W. (V.-P. 1889-91. C. 1883-6. T. 1891-8.)

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1881 Cross, F. R. (V.-P.), Worcester House, Clifton, Bristol. (C. 1891-4.)

O.M. Davidson, A. Deas, M.D., 9, Picton Place, Swansea. (C. 1895-6.)

1884 Davidson, James McKenzie, M.B., 76, Portland Place, W. (C. 1892-5.)

1889 †Davis, G. C., 3, Hyde Park Terrace, 173, Liverpool Street, Sydney, New South Wales.

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1882 †Dodge, Stephen, M.D., Halifax, Nova Scotia.

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1890 Douty, Edward Henry. M.B., B.C., 69, Bridge Street, Cambridge.

1887 Doyne, Robert W., 64, St. Giles', Oxford. (C. 1892-5.)

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1889 †Drake-Brockman, Herbert E., Mirzapur, India.

1895 Du Boulay, H. H., 2, Royal Terrace, Weymouth.

O.M. Duncanson, J. J. Kirk, M.D., 22, Drumsheugh Gardens, Edinburgh.

1886 Dunn, Hugh Percy, 54, Wimpole Street, Cavendish Square, W.

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O.M. *Edmunds, Walter, M.D., 75, Lambeth Palace Road, Albert Embankment, S.E. (C. 1885-8.)

1883 *Emrys-Jones, A., M.D., 10, St. John Street, Manchester.

1887 Ensor, Henry C., 23, Windsor Place, Cardiff.

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1891 Evill, F. Claude, M.R.C.S., L.R.C.P., Hadleycote, Hadley Green, Barnet.

1896 Eyre, John W. H., M.D., 14, Trinity Square, S.E.

1888 Fergus, A. Freeland, M.B., 203, Bath Street, Glasgow.

1888 †Ferguson, Alex. F., M.D., care of Messrs. Grindlay, Groom & Co., Bombay.

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ELECTED

1889 Ferrier, David, M.D., F.R.S., 34, Cavendish Square, W. (C. 1896-7.)

1894 Fischer, E. C., M.B., Royal London Ophthalmic Hospital, Moorfields, E.C.

1895 Fisher, J. Herbert, M.B., 34, Queen Anne Street, Cavendish Square, W.

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1889 Flemming, Percy, 31, Wimpole Street, W.

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1891 Forward, Francis E., Holberton Institution, St. John's Antigua, W.I.

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1883 †Da Gama, Jerminio Accacio, Khoja Moola, Bombay.

1895 Galloway, A. Rudolf, M.B., 250, Union Street, Aberdeen, N.B.

1887 †Gardner, John J., M.D., 12, Phillip's Place, Montreal, Canada.

1889 Gibbs, Alfred N. G., 52, Whiteladies Road, Clifton.

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O.M. Gowers, Sir W. R., M.D., F.R.S. (V.-P.), 50, Queen Anne Street, W. (C. 1880-3.)

1897 Granger, F. M., 18, Nicholas Street, Chester.

1895 †Grant, H. Y., M.D., 414, Delaware Avenue, Buffalo, U.S.

ELECTED

1895 †Gray, James, M.D., 119, Robert Street, Toronto, Canada.

1887 Green, Edwin Collier, 27, Friar Gate, Derby.

1896 Grey-Edwards, Henry, M.D., Bank Place, Bangor, N. Wales.

1895 Griffin, W. Watson, M.B., 34, Regency Square, Brighton.

1885 *Griffith, A. Hill, M.D., 17, St. John Street, Manchester. (C. 1893-6.)

1890 Griffith, John, 7, Grafton Road, Acton, W.

1894 Grimsdale, Harold, M.B., 114, Harley Street, W.

O.M. Grossmann, K. A., 70, Rodney Street, Liverpool.

1889 Gunn, Donald S., 66, Wimpole Street, W.

O.M. Gunn, R. Marcus (V.-P.), 54, Queen Anne Street, W. (C. 1882-5, 1889-92. S. 1886-9.)

1898 Guthrie, Leonard G., M.D., 15, Upper Berkeley Street, W.

1887 Habershon, Samuel Herbert, M.D. (C.), 70, Brook Street, Grosvenor Square, W. (S. 1894-7.)

1889 Hailes, C. D. G., M.D., Hawkesdale, 27, Alma Road, Clifton.

1885 †Haines, Humphrey, Auckland, New Zealand.

1896 Hamilton, Robert J., 42, Rodney Street, Liverpool.

1878 †Hamilton, T. K., M.D., Wakefield Street, Adelaide, South Australia.

1886 Hartley, Robert N., M.B., 38, Cookridge Street, Leeds.

1882 *Hartridge, Gustavus, 12, Wimpole Street, W. (C. 1889-92. S. 1892-5. C. 1895-8.)

1892 Haydon, Frank, 55a, Welbeck Street, Cavendish Square, W.

1896 Henry, R. Wallace, M.D., 4, Market Street, Leicester.

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1887 Hern, John, M.D., Semmercote, Darlington.

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ELECTED

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O.M. Higgens, Charles, 38, Brook Street, W. (C. 1880-3.)

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1898 Hopkinson, Emilius, St. Thomas's Hospital, S.E.

1893 †Howe, Lucien, 183, Delaware Avenue, Buffalo

1884 †Hudson, Ernest, Central Gaol, Benares, N.W.P., India.

1889 †Hughes, Samuel H., Gingola, Mowbray Road, Willoughby, Sydney, New South Wales.

1893 †Hughes, Wilfrid Kent, M.B., 102, Collins Street, Melbourne.

O.M. Hutchinson, Jonathan, F.R.S., 15, Cavendish Square, W. (*Pres.* 1883-6. V.-P. 1880-1, 1886-9.)

1883 †Jackson, James, M.D., Collins Street East, Melbourne, Australia.

O.M. Jackson, J. Hughlings, M.D., F.R.S., 3, Manchester Square, W. (*Pres.* 1889-90. V.-P. 1880-2, 1890-3.)

1888 James, J. T., M.D., 30, Harley Street, W.

O.M. Jeaffreson, C. S., 24, Eldon Square, Newcastle-on-Tyne.

1883 †Jenkins, E. J., M.D., Nepean Towers, Douglass Park, Sydney, N.S.W., Australia.

1883 Jessop, W. H. H., 73, Harley Street, W. (C. 1889-92.)

1882 Johnson, G. Lindsay, M.B., Cortina, 24, Netherhall Gardens, South Hampstead.

1888 †Johnston, Geo. D., Georgia Street, Vancouver, British Columbia.

O.M. Jones, Evan, Ty-mawr, Aberdare, Glamorganshire.

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1897 Jones, Hugh E., 7, Rodney Street, Liverpool.

ELECTED

1894 †Jones, R. H., M.B., B.S., 209, Macquarie Street, Sydney, New South Wales.

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1897 Kemp, Charles, M.B., C.M., 22, India Street, Edinburgh.

1898 †Kendall, H. W. Martindale, Wellington, New Zealand.

1888 †Kenny, Augustus Leo, M.B., 87, Collins Street, Melbourne, Victoria, Australia.

1890 Keogh, Alfred H., Surgeon-Major, M.D., M.Ch., Station Hospital, Barrackpore, Bengal, India.

1891 Kingdon, E. C., M.B., C.M., 4, Upper College Street, Nottingham.

1895 Knaggs, Robert Lawford, M.D., 27, Park Square, Leeds.

1881 †Knaggs, S. T., M.D., 16, College Street, Hyde Park, Sydney, New South Wales.

O.M. Lang, William, 22, Cavendish Square, W. (C. 1886-9.)

1881 Langdon, J. Winkley, 4, Winkley Square, Preston.

O.M. Lawford, J. B. (C.), 99, Harley Street, Cavendish Square, W. (C. 1886-9. S. 1895-8.)

1889 *Laws, Wm. G., M.B., 3, East Circus Street, Nottingham.

1896 Lawson, Arnold, M.D., 12, Harley Street, W.

O.M. Lawson, George, 12, Harley Street, Cavendish Square, W. (C. 1882-4. V.P. 1892-5.)

1895 †Lea, J. Augustus, M.B., Royal Colonial Institute, Northumberland Avenue, W.C.

1893 Leahy, Surg.-Major A. W. D., M.D., Indian Medical Service, 6, Elysium Row, Calcutta.

1885 †Le Cronier, Hardwick, St. Heliers, Jersey.

O.M. Lediard, H. A., M.D., 35, Lowther Street, Carlisle.

1885 Lee, Charles G., 73, Rodney Street, Liverpool.

1896 Lister, W. T., M.B., Rose Hill, Totteridge, Herts.

O.M. Little, David, M.D., 21, St. John Street, Manchester. (V.-P. 1888-91. C. 1880-1.)

ELECTED

1892 Lodge, Samuel, jun., M.D., 13, Manningham Lane, Bradford.

1883 Lunn, J. R., Resident Medical Officer, Marylebone Infirmary, Notting Hill, W. (C. 1892-5.)

1892 Macarthur, Robert F., M.B., 32, Weymouth Street, Portland Place, W.

1888 Mackay, George, M.D., 20, Drumsheugh Gardens, Edinburgh.

O.M. Mackenzie, F. M., 29, Hans Place, S.W.

1889 †Mackenzie, F. Wallace, M.B., 139, Upper Willis Street, Wellington, New Zealand

O.M. Mackenzie, Stephen, M.D., 18, Cavendish Square, W. (S. 1880-2. C. 1882-5. V.-P. 1893-6.)

O.M. Mackinlay, J. G., 15, Stratford Place, W. (C. 1888-90.)

1889 MacLehose, Norman M., M.B., 13, Queen Anne Street, Cavendish Square, W.

1897 Maclennan, Duncan N., M.D., Moorfields Eye Hospital, E.C.

1892 †MacLeod, Charles G., M.B., 26, College Street, Hyde Park, Sydney, N.S.W.

1881 †Maconachie, G. A., Brigade Surgeon Lieutenant-Colonel, M.D., 39, Queen's Road, Aberdeen.

1883 †Maher, W. O., M.D., 20, College Street, Hyde Park, Sydney, N.S.W.

1883 †Marlow, Frank William, M.D., 401, Montgomery Street, Syracuse, New York State, U.S.A.

1892 Marshall, Charles Devereux, 10, Devonshire Street, Portland Place, W.

1888 †Martin, Albert, M.D., Wellington, New Zealand.

1884 Maxwell, Patrick William, M.D., 19, Lower Baggot Street, Dublin.

1893 Maynard, Frederic Pinsent, Surgeon-Captain, M.B., Indian Medical Service, care of Grindlay and Co., Calcutta.

1890 McGillivray, Angus, M.D., 23, South Tay Street, Dundee, N.B.

ELECTED

O.M. McHardy, M. M., 5, Savile Row, W. (C. 1887-90.)

1895 †McIntosh, J. R., M.D., 44, King Square, St. John, New Brunswick, Canada.

1895 McKenzie, H. V., M.D., Elmbank, Abbey Road, Torquay.

1884 McKeown, David, M.D., 25, St. John Street, Manchester.

1884 McKeown, W. A., M.D., 20, College Square East, Belfast.

O.M. Meighan, T. S., M.D., 15, Elmbank Street, Glasgow.

1897 Miller, G. Victor, M.B., 2, Barrington Crescent, Stockton-on-Tees.

1881 †Milles, W. Jennings, care of Drs. Henderson and Macleod, Shanghai, China.

1897 Minnes, Robert Stanley, M.D., 122, Bagot Street, Kingston, Ontario, Canada.

1896 Mooney, Herbert C., M.B., 22, Lower Baggot Street, Dublin.

O.M. Morton, A. Stanford, 133, Harley Street, W. (C. 1886-9.)

1890 Mowat, Daniel, M.D., St. Ninian's, 93, Stamford Hill, N.

O.M. Mules, P. H., M.D., Gresford, Wrexham. (C. 1886-9.)

1891 Myddelton-Gavey, Edward Herbert, 124, Harley Street, W., and Tunbridge Wells.

1893 Napier, F. H., M.B., B.S., 18, Brandon Place, Glasgow.

O.M. *Nelson, Joseph, M.D., 29, Wellington Place, Belfast. (C. 1893-5.)

O.M. *Nettleship, Edward (V.-P.), 5, Wimpole Street, W. (*Pres.* 1895-7. S. 1880-3. C. 1883-6. V.-P. 1886-9.)

1881 Nicholson, A., 30, Brunswick Square, Brighton.

1895 *Ogilvie, F. Menteith, M.B., 5, Evelyn Mansions, Victoria Street, S.W.

1895 Ogilvy, Alexander, M.B., Montrose House, Clifton.

ELECTED

1889 †O'Kinealy, Frederick, Surg.-Capt. I.M.S., care of Messrs. King, Hamilton, and Co., 7, Hare Street, Calcutta.

1884 Oldham, Charles J. (C.), 38, Brunswick Square, Brighton.

1881 Ormerod, J. A., M.D., 25, Upper Wimpole Street, W. (C. 1891-4.)

1892 †Orr, Andrew William, M.D., A.M.P. Buildings, Edward Street, Brisbane.

1890 †Osborne, A. B., M.D., 46, McNab Street South, Hamilton, Canada.

O.M. Owen, D. C. Lloyd, 41, Newhall Street, Birmingham. (V.-P. 1891-4.)

O.M. Page, Herbert W., 146, Harley Street, W. (C. 1890-3.)

1890 †Palmer, L. Loran, M.D., 42, St. George Street, Toronto, Ontario, Canada.

1894 *Parker, Herbert, 7, Bloomsbury Place, W.C.

1893 Part, J. Shepley, 20, Ashchurch Park Villas, Goldhawk Road, Ravenscourt Park, W.

1887 †Patell, D. H., 12, Ragoonatti Dadagi Street, Fort, Bombay.

1897 Pearson, Maurice Grey, M.B., care of W. G. Pearson, Esq., 97, Cannon Street, E.C.

1897 Pechell, Horace James, M.B., 12, Church Street, Merthyr Tydvil.

O.M. Penfold, Henry, 7, Brunswick Place, Brighton.

1891 Perry, A., Surgeon-Major, Principal Civil Medical Officer, Ceylon.

1889 †Perry, Francis F., Lahore Medical College, Punjab, India.

1888 Percival, Archibald Stanley, M.B., B.Ch., 16, Ellison Place, Newcastle-on-Tyne.

1889 Phillips, T., 124, Harley Street, W.

1895 Pickard, Ransom, M.D., 31, East Southernhay, Exeter.

ELECTED

1896 Pooley, G. H., Royal Westminster Ophthalmic Hospital.

1894 †Pope, R. J., M.D., Box 497, G.P.O., Sydney, N.S.W.

O.M. Power, Henry, 37a, Great Cumberland Place, W. (*Pres.* 1890-3. V.-P. 1882-5, 1893-6. C. 1880-2.)

1888 Price, John A. P., M.D., 124, Castle Street, Reading.

1882 Prichard, Arthur William, 6, Rodney Place, Clifton.

1892 Pronger, Charles Ernest, East Parade, Harrogate.

O.M. Purves, W. Laidlaw, 20, Stratford Place, Oxford Street, W.

1888 Rainy, Adam R., M.B., 6, Upper Wimpole Street, W.

1889 Ramsay, A. Maitland, M.D., 15, Woodside Place, Glasgow.

1881 †Reeve, R. A., M.D., 22, Shuter Street, Toronto, Canada.

O.M. Reid, Thomas, M.D., 11, Elmbank Street, Glasgow. (V.-P. 1884-7.)

1885 Renton, James Crawford, M.D., 1, Woodside Terrace, Glasgow.

1891 Reynolds, Austin Edward, 81, Hornsey Rise, N.

1897 Richmond, R., M.D., Brook House, Great Bardfield, Essex.

1892 Ridley, Nicholas C., M.B., 27, Horse Fair Street, Leicester.

1897 Rivers, W. H. R, M.D., St. John's College, Cambridge.

1885 *Roberts, Edward, 12, St. John Street, Deansgate, Manchester.

1896 †Roberts, J. R., Surgeon-Captain, M.B., care of Messrs. King, King and Co., Bombay.

O.M. *Robertson, D. Argyll, M.D. (V.-P.), 18, Charlotte Square, Edinburgh. (*Pres.* 1893-95. V.-P. 1881-2, 1886-9. C. 1895.)

1891 Robertson-Fullarton, Archibald Louis, M.B., C.M., 201, Bath Street, Glasgow.

O.M. Rockliffe, W. C., M.D., 17, Charlotte Street, Hull. (C. 1892-5.)

ELECTED

1898 Roe, Arthur Legge, 45, Pryme Street, Hull.

1890 Rolston, John R., 14, The Crescent, Plymouth.

1891 Roper, Arthur Charles, The Shrubbery, Exeter.

1893 Ross, J. A., M.D., Box 208, Barrie, Ontario, Canada.

1882 †Roth, Reuter E., 42, College Street, Hyde Park, Sydney, New South Wales.

1893 Rowan, John, M.B., 7, Blythswood Square, Glasgow, N.B.

1881 †Rudall, J. T., 61, Spring Street, Melbourne, Australia.

1895 Russell, J. S. Risien, M.D., 4, Queen Anne Street, Cavendish Square, W.

1888 †Sanders, Richard C., M.D., 36, Chowringhee, Calcutta.

1884 *Sandford, Arthur W., M.D. (C.), 13, St. Patrick's Place, Cork.

1881 *Sansom, A. E., M.D., 84, Harley Street, W. (C. 1893-5.)

O.M. Savage, G. H., M.D., 3, Henrietta Street, Cavendish Square, W. (C. 1892-4.)

1891 Schorstein, Gustave, M.D., 11, Portland Place.

1888 Scott, Kenneth, Cairo, Egypt.

1892 Shannon, John Rowlands, M.D., 18, West 35th Street, New York.

O.M. Sharkey, S. J., M.D., 22, Harley Street, W. (S. 1885-8. C. 1888-91.)

1894 Shaw, Cecil E., M.D., 14, College Square East, Belfast.

1883 Shears, Charles H., 19, Upper Duke Street, Rodney Street, Liverpool.

1892 Sheppard, Arthur Murray, M.B., 2, Temple Gardens, E.C.

1883 Silcock, A. Q., 52, Harley Street, W. (S. 1889-92. C. 1892-5.)

1893 Simpson, R. J. S., M.B., care of Messrs. Holt and Co., Whitehall Place, S.W.

1891 Sinclair, Walter William, 16, Museum Street, Ipswich.

ELECTED

1889 Smith, John, M.D., Brycehall, Kirkcaldy, N.B.

O.M. Smith, Priestley (V.-P.), 34, Paradise Street, Birmingham. (V.-P. 1887-90. C. 1883-6.)

1881 Smith, T. Gilbart, M.D., 68, Harley Street, W.

O.M. Snell, Simeon, 70, Hanover Street, Sheffield. (C. 1884-7. V.-P. 1892-5.)

1889 Spencer, Matthew H., M.B., B.Ch., 95, St. Mark's Road, North Kensington, W.

1889 Spicer, Wm. T. Holmes, M.B., 47, Welbeck Street, W.

1897 Square, James Elliot, 22, Portland Square, Plymouth.

1895 †Stamberg, A. C., M.B., 5, Windsor Terrace, St. Heliers, Jersey, Channel Islands.

1886 Stephenson, Sydney H. A. (C.), M.B., 33, Welbeck Street, W.

1896 Stevenson, Edgar, M.D., 67, Rodney Street, Liverpool.

1893 Stirling, Alexander Williamson, M.D., Atlanta, Georgia.

1887 †Stirling, J. W., M.B., 873, Dorchester Street, Montreal, Canada.

O.M. Story, J. B., 6, Merrion Square North, Dublin. (C. 1885-8. V.-P. 1894-7.)

O.M. †Sturge, W. A., M.D., 15, Rue Longchamp, Nice, Les Alpes Maritimes.

O.M. Swanzy, H. R. (*Pres.*), 23, Merrion Square North, Dublin. (V.-P. 1880-1, 1889-92.)

1888 Sym, William George, M.D., 20, Alva Street, Edinburgh.

1883 †Symons, Mark Johnston, M.D., North Terrace, Adelaide, South Australia.

1886 Sympson, E. Mansel, M.D., Deloraine Court, Lincoln.

1898 Tait, Edward Sabine, M.D., 48, Highbury Park, N.

O.M. Tay, Waren, 4, Finsbury Square, E.C. (C. 1880-2.)

1882 Taylor, C. Bell, M.D., Beechwood Hall, Mopperley Park, Notts.

ELECTED

1891 Taylor, James, M.D. (S.), 49, Welbeck Street, W. (C. 1894-7.)

1889 Taylor, S. J., M.B., 34, Prince of Wales' Road, Norwich.

O.M. Teale, T. Pridgin, F.R.S., 38, Cookridge Street, Leeds. (V.-P. 1880-1.)

O.M. Thomas, Jabez, Ty-Cerrig, Swansea.

1895 Thompson, Arthur Hugh, M.B., Lawn House, Hampstead.

1885 Thompson, C. Sinclair, The Quay, Bideford, Devon.

1895 Thompson, George W., M.B., Sunnymede, Muswell Hill, N.

1888 Thompson, John Tatham, M.B., 24, Windsor Place, Cardiff.

1895 Thompson, Robert, M.D., B.S., Dalkeith House, Wharf Street, Brisbane.

1898 Thomson, W. Ernest, M.D., 17, Berkeley Terrace, Glasgow.

1883 †Tobin, William, 31, Hollis Street, Halifax, Nova Scotia, Canada.

1895 Toombs, Herbert George, 24, Marloes Road, Kensington, W.

1883 Tooth, Howard H., M.D. (C.), 34, Harley Street, W.

O.M. Tosswill, L. H. (C.), 28, West Southernhay, Exeter.

1890 Turner, William Aldren, M.D (C.), 13, Queen Anne Street, W.

O.M. Tweedy, John, 100, Harley Street, W. (C. 1884-7. V.-P. 1891-4.)

1898 Tyrrell, F. Astley Cooper, M.B., St. Thomas's Hospital, S.E.

1883 Uhthoff, J. C., M.D., Wavertree House, Brunswick Place, Brighton.

1894 Usher, C. H., M.B., 3, Bon Accord Square, Aberdeen.

O.M. Vernon, Bowater J., 14, Clarges Street, Mayfair, W.

1887 Wainewright, Benjamin, M.B., 67, Grosvenor Street, W.

ELECTED

1888 Walker, Cyril H., M.B., 3, Leicester Villas, St. Paul's Road, Clifton.

O.M. Walker, G. E., 45, Rodney Street, Liverpool.

1892 Walker, H. Secker, 44a, Park Square, Leeds.

1893 Warner, F. Ashton, 10, Brechin Place, S.W.

1893 Warren, H. Guy S., 205, Macquarie Street, Sydney.

O.M. Watson, W. Spencer, 60, Queen Anne Street, Cavendish Square, W. (C. 1883-6.)

1893 †Weekes, Charles Jones, 36, College Street, Hyde Park, Sydney.

1887 Wells, Arthur P. L., M.B. (C.), 83, Harley Street, W.

1885 Werner, Louis, M.B., 31, Merrion Square North, Dublin.

O.M. West, Samuel, M.D., 15, Wimpole Street, W. (C. 1888-91.)

O.M. *Wherry, G. E., M.B. (C.), Corpus Buildings, Cambridge.

1892 White, G. B. Mower, M.B., 112, Harley Street, W.

1895 Whitehead, Arthur Longley, M.B., 4, Park Square, Leeds.

O.M. Williams, R. (V.-P.), 82, Rodney Street, Liverpool.

1894 Williams, W. E., M.B., Portmadoc, Carnarvonshire.

1889 Williamson, Geo. E., 8, Eldon Square, Newcastle-on-Tyne.

1888 †Willis, C. Fancourt, M.D., Quetta, Baluchistan, India.

1889 Wood, David J., M.B., Colonnade Chambers, 17, Shortmarket Street, Cape Town, South Africa.

1889 Woodburn, William Harrison, Kent Place, Ulverston.

O.M. Woodhead, G. Sims, M.D., Beverley, Nightingale Lane, Balham, S.W. (C. 1894-5.)

1890 *Wray, Chas., Bank Chambers, North End, Croydon.

1898 Wright, Edward Wm., M.D., 115, Montague Street, Brooklyn, New York.

1896 Yarr, M. T., Major, R.A.M.C., 91, Victoria Street, Westminster, S.W.

RULES.

1. Object of the Society.—The object of the Society is the cultivation and promotion of Ophthalmology in the United Kingdom, India, and the Colonies.

2. Constitution.—The Society shall consist of Ordinary and Honorary members. All registered medical practitioners of the United Kingdom, and all legally qualified medical men in India and the colonies, whose qualifications are satisfactory to the Council of the Society, shall be eligible as ordinary members.

3. The officers of this Society shall consist of a President, four or more Vice-Presidents, a Treasurer, two Secretaries, a Librarian, and twelve other members, who together shall form the Council and manage the Society's affairs.

4. Ordinary Members.—Candidates shall be proposed on a form provided for the purpose and signed by three members from personal knowledge. The proposal paper shall be read at one Ordinary Meeting, and the Ballot shall be taken at the following meeting. No election shall take place unless ten members vote, and no person shall be elected who does not obtain four fifths of the votes given.

5. Form of Admission by the Chairman.—Members shall be admitted personally by the following form, after signing their names in the Admission Book, and paying their first annual Subscription. *Form of admission.*—"By the authority and in the name of the Ophthalmological Society of the United Kingdom, I admit you a member thereof."

6. Honorary Members.—The Council shall have the power of proposing for election as Honorary members men of distinguished eminence in Ophthalmology, or in the sciences

bearing upon it. They shall be elected by ballot in the same manner as Ordinary members at the next meeting. The Honorary members shall not exceed ten in number.

7. Resignation of Members.—Any member may retire from the Society after signifying his intention in writing to the Secretaries and paying any contribution due from him.

8. Re-admission of Members.—Any member who has retired from the Society and wishes to rejoin it, must be proposed, balloted for, and admitted in accordance with Rules 4 and 5.

9. Expulsion of Members.—A member can be expelled only at a General Meeting especially called for that purpose, and of which a written notice shall have been sent to every member at least fourteen days previously. At least ten votes must be recorded, and four fifths shall carry the expulsion.

10. Subscriptions.—The Annual Subscription shall be One Guinea, payable in advance in the month of October. Each member on election shall pay an Entrance Fee of One Guinea in addition to the Subscription, but in the case of a member elected at a meeting of the Session subsequent to Easter he shall not be required to pay a Subscription during the next Session.

11. Arrears.—Any member whose Subscription is six months in arrear shall be reminded of the same by one of the Secretaries, and if it be not paid within the current year he shall cease to be a member.

12. Composition Fee for Resident Members.—Any member may on entrance pay a Composition Fee of Fifteen Guineas, and be thereby exempted from paying any further Subscriptions, such member enjoying all the same rights and privileges as if he were a Subscribing member. After entrance, the Composition Fee will be according to the following scale:—After less than five payments Fourteen Guineas, after five payments Thirteen Guineas, after ten payments Twelve Guineas, after fifteen payments Eleven Guineas, after twenty payments Ten Guineas, after twenty-five payments Eight and a Half Guineas, after thirty payments Seven Guineas, after thirty-five payments Five Guineas, after forty payments Two and a Half Guineas, and after forty-five payments *nil*.

13. Composition Fees for Non-Resident Members.—Any

member resident out of the United Kingdom may pay a Composition Fee of Seven Guineas instead of the Annual Subscription, and will then be entitled to receive, post free, a copy of the Society's 'Transactions' each year, and to have his name printed in the list of members; but if at any time he subsequently become a Resident member of the Society, he shall resume the payment of his Annual Subscription at the end of six years from the date of his election, or if more than six years have elapsed, from the date of his return to residence. The question of further composition by him shall be decided by the Council. N.B.—The Composition Fee will be held to include the Entrance Fee if paid any time during the First Session.

14. Election of Officers.—The Officers of the Society shall be elected yearly by Ballot at the Annual Meeting. A Balloting list of the names recommended by the Council for election shall be sent to each Resident member, together with the notice of the Annual Meeting. In the event of any name being substituted for any recommendation of the Council, the election shall not be valid unless effected by a majority of those present at the meeting. The President shall not hold office for a period of more than two consecutive years. No other member of the Council, except the Treasurer and the Librarian for the time being, shall hold the same office for more than three consecutive years. Any ordinary member of Council who has been absent from all the meetings of the Council for one session shall not be eligible for election to the Council for the ensuing session.

15. Scrutineers.—Two Scrutineers appointed by the President at the commencement of the Annual Meeting shall receive the lists during the first hour, and report the result to the President, who shall have a casting vote.

16. President and Vice-Presidents.—The President shall regulate all the proceedings of the Society and Council, state and put questions, interpret the application of the laws, and decide any doubtful points. He shall check irregularities and enforce the observance of the laws He shall sign the minutes of General and Council Meetings. In the absence of the President one of the Vice-Presidents, the Treasurer, or some other member chosen by the meeting, shall perform his duties.

17. Secretaries.—The Secretaries shall manage all correspondence, shall attend every meeting of the Society and Council, and take minutes, which shall be read at the following meeting. They shall notify to new members their election. They shall arrange with the President the order of proceedings at all the meetings. They shall have charge of and keep a register of all papers communicated, and shall be the Editors of the 'Transactions.'

18. Treasurer.—The Treasurer shall receive all moneys due to the Society, and make all payments ordered by the Council, keeping an account of all such receipts and payments. He shall keep a printed receipt book for the subscriptions, and every receipt shall be signed by himself and countersigned by one of the Secretaries. He shall present to the Annual Meeting a written Report of the financial state of the Society, signed by himself and by two members of the Audit Committee.

19. Librarian.—The Librarian shall have entire charge and control of the Library. He shall purchase books for the Library as opportunities arise at his discretion out of the grant previously voted for this purpose by the Council. He shall see that all books belonging to the Society are duly entered in the Catalogue, and that the periodicals and pamphlets are from time to time, as occasion may require, suitably bound. It will be his duty to see that the Library Rules are not infringed.

20. Audit Committee.—The President, one of the Secretaries and two members of the Society nominated by the President at some meeting of the Society previous to the Annual Meeting, shall form a Committee to audit the Treasurer's accounts.

21 Meetings of Council.—The Council shall meet immediately after the meetings in October, January, May, and June, and at such other times as they may be specially convened. Three shall form a quorum. The Council shall determine questions by show of hands (or by Ballot if demanded), the President having in both cases a casting vote in addition to his ordinary vote. The Council shall decide upon all questions relating to the reception of communications, and to their publication in the Society's 'Transactions.'

22. Vacancies of Officers.—The Council shall have the power of filling up any vacancies which may occur in any of

the offices of the Society between one Annual Meeting and another.

23. 'TRANSACTIONS.'—A copy of the 'Transactions' shall be sent to each Ordinary member of the Society whose subscription is not in arrear, and a copy of the 'Transactions' shall be sent to each Honorary member of the Society.

24. MEETINGS.—These shall consist of Ordinary, Clinical, Special, and General Meetings.

Ordinary Meetings.—The business during the first half-hour shall consist of the discussion of cases and card specimens, after which papers shall be read and discussed. Nothing relating to the laws or management of the Society shall be considered.

Clinical Meetings.—One or more of the meetings in each session may be devoted exclusively to the exhibition and discussion of cases and specimens. The number and dates of such meetings shall be arranged by the President and Secretaries.

The bye-laws and regulations relating to Ordinary and Clinical Meetings will be found on page xxxvii.

Special Meetings.—At the discretion of the Council an extra meeting may be arranged in order to hold a discussion upon some subject, of which due notice shall be given, or one of the Ordinary Meetings of the Society may be devoted to this purpose.

General Meetings.—The Annual General Meeting, of which every resident member shall receive one week's notice, shall be convened by special summons; ten shall form a quorum. It shall be held immediately after the Ordinary Meeting in July. The business shall consist in the election of Officers, the presentation and adoption of the Annual Report, and the discussion of any proposed alteration of the Rules, notice of which shall be given in the summons convening the meeting. No alteration in the Rules shall be adopted unless four fifths of the votes are given in its favour.

A Special General Meeting may be called at any time, on one week's notice, by the President or any three members of the Council, or on the requisition of fifteen members of the Society. The nature of the business to be transacted at such meetings

shall be specified in the summons sent to each member of the Society, and no other business shall be considered.

Dates and Hours of Meetings.—The dates of meetings shall be, unless otherwise determined by the Council, the third Thursday in October, the second Thursday in November and December, the last Thursday in January, the second Thursday in March, the first Thursday in May, the second Thursday in June, and the Friday after the first Thursday in July. All but the General and Special Meetings shall commence at 8.30, and shall not be prolonged after 10 p.m., except on the proposal of a member, duly seconded, and carried by a show of hands. The hour of all other meetings shall be determined by the President and Secretaries.

25. Visitors.—Each member may introduce as visitors two members of the medical profession to all but the General Meetings. They shall sign their names in the attendance book, opposite to the name of the member introducing them.

26. Order of Communications.—Communications shall be taken in the order in which they have been sent in to the Secretaries, subject to the discretion of the President. If an author be not present when the time arrives for his communication to be read, it shall be dealt with as the President may direct.

27. Publication of Papers and Discussion.—All papers must be sent to the Secretaries at least one week before the meeting, together with an abstract suitable for immediate publication in the journals. When possible, notice should be given relating to card cases, &c. All papers read before the Society shall be deemed the exclusive property of the Society, and if published elsewhere by the author without the express permission of the Council shall thereby be disqualified for admission into the Society's 'Transactions.' No report of the meetings of the Society may be published by members or others without the sanction of the Council.

28. Committee of Reference.—Six members of the Society shall be chosen annually by the Council to act with the Secretaries as a Committee of Reference, and any communication to the Society may be referred by the Secretaries to two or more members of such Committee of Reference, for the

purpose of considering the fitness of the communication in question to be read before the Society, or to be published in the Society's 'Transactions.'

LIBRARY RULES.

1. The Library shall be open at the same hours as that of the Medical Society, viz. from 1 p.m. to 6 p.m. daily, except on Saturdays, when it will be closed at 3 p.m.

2. Members will be entitled to read the books belonging to the Society at 11, Chandos Street, between those hours, or to take them out on signing a book provided for that purpose. But any books of extraordinary value may be placed by the Council on a separate list, such books not being allowed to be removed from the Library.

3. A large number of the current periodicals will be accessible to members in the Library. These will not be allowed to be taken out of the Library.

4. A book must be returned at the expiration of a fortnight if wanted by any other member. The Librarian will in such a case write to the member in whose name the book was taken out.

5. If the book be not returned within four days of such notice a fine of 6d. will be charged for each day that the book is retained beyond such days of grace.

6. Instruments and drawings cannot be taken out of the Library except with the express permission of the Council.

7. A member taking out a book will be held responsible for its being returned in good condition.

THE BOWMAN LECTURE.

Resolution of Council, September 18th, 1883.

"That in recognition of Mr. Bowman's distinguished scientific position in ophthalmology and other branches of Medicine, and

in commemoration of his valuable services to the Ophthalmological Society, of which he was the first President, the Council shall each year, or periodically, nominate some person to deliver a lecture before the Society, to be called 'The Bowman Lecture,' which shall consist of a critical *résumé* of recent advances in ophthalmology or in such subject or subjects as the Council shall select, or of any original investigation, and shall be delivered at a special meeting of the Society held for the purpose, at which no other business shall be transacted."

BYE-LAWS CONCERNING COMMUNICATIONS.

1. The 'Transactions' shall consist of such communications, made to the Society by or through members, as may be deemed by the Council suitable for publication. Also of discussions of importance or interest arising out of such communications.

2. No communication to the Society shall occupy more than twenty minutes, and in the subsequent discussion of it no member shall speak more than once, or for more than ten minutes, without the special permission of the Chairman.

3. All communications accepted by the Society become the property of the Society.

4. Communications are admissible which may have been read elsewhere, provided they have not been published, and are not intended to be published, in whole or in abstract, through another channel.

5. The cost of illustrations must be borne by the authors, unless otherwise specially decided by the Council.

6. Reprints of papers may be obtained by authors at their own expense, by arrangement with the printer.

REGULATIONS CONCERNING THE EXHIBITION OF PATIENTS AND OF PATHOLOGICAL SPECIMENS BY CARD.

A. Patients must attend not later than 8 p.m., and will be allowed to leave at 9.30. A card, provided by the Society, must be placed conveniently near the patient (unless it is undesirable that it should be read by the patient or friends), and on it must be clearly written an account of the case, *comprising all the particulars intended for publication*. The title only of the case will be announced by the President to the meeting, but the Exhibitor (or his representative) must be present at the meeting, and be willing to read the case and furnish additional details if called upon to do so; the length of such oral communications not to exceed five minutes.

The narration and discussion of Card Specimens shall not occupy more than the first half-hour of the meeting.

B. Pathological Specimens may, at the discretion of the Exhibitor, be shown by card, and will then be subject to the above regulations. It is particularly to be noted that the description on the card must *comprise all the particulars intended for publication.*

REGULATIONS FOR CLINICAL EVENINGS.

1. Notice of cases or specimens should be sent in to the Surgical Secretary as early as possible, but not later than the Thursday preceding the meeting.

2. Cases and specimens may be shown without previous notice if there is time, but not until all on the printed list have been disposed of.

3. The number of cases to be shown by any member, and the total number on one evening, to be left to the discretion of the President and Secretaries.

4. A list of the cases and specimens to be sent before the meeting to every member in the kingdom.

5. Particulars of each case to be fully written out before the meeting, and given to the Secretaries at the close of the meeting.

6. A short abstract of the case to be written on the card provided for the purpose, and placed by the patient.

7. The narration of a case shall not occupy more than five minutes, and in the subsequent discussion no member shall speak more than once or for more than five minutes.

8. Patients and specimens to be in place and ready by 8 p.m., one of the Secretaries being in attendance.

9. Unless it be thought undesirable, each patient shall be brought into the meeting room during the narration of the case.

10. If the exhibitor or his representative be not present the case cannot be taken.

11. A case which has been shown at one of the Ordinary Meetings may be subsequently brought forward at a Clinical Evening.

LIST OF COMMUNICATIONS

BROUGHT BEFORE THE SOCIETY DURING THE SESSION 1897-98.

PAGE

On some of the Congenital Anomalies of the Eye, as illustrated in the 'Transactions' of the Society; being an Inaugural Address delivered before the Ophthalmological Society of the United Kingdom on October 21st, 1897.
By Henry R. Swanzy, M.B., F.R.C.S.I., President 1

On the Etiology and Educative Treatment of Convergent Strabismus: being the Bowman Lecture delivered on Friday, June 10th, 1898. By Priestley Smith 17

I. DISEASES OF THE EYELIDS.

1. Lupus of the intermarginal space of each lower lid. By Sydney Stephenson 49
2. Phagedæna of eyelids. By Gustavus Hartridge 50
3. Large fibroma of upper eyelid. By Simeon Snell 52

II. DISEASES OF THE CONJUNCTIVA.

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1. Urticaria perstans with affection of the conjunctiva. By L. Vernon Cargill 53
2. On epithelial xerosis of the conjunctiva. By Sydney Stephenson 55
3. Epithelial xerosis in natives of India. By Surgeon-Captain H. Herbert 103
4. Pemphigus of the conjunctiva. By Charles Wray 104
5. Recurrent conjunctival membrane. By Rayner D. Batten 105
6. Œdema of the conjunctiva, due to obstruction of the lymph streams. By W. T. Holmes Spicer 106
7. Large subconjunctival cyst. By Simeon Snell 112

III. DISEASES OF THE CORNEA.

1. Case of keratitis. By John R. Rolston 115
2. Operation for transverse calcareous films of both corneæ. By Poulett Wells 116
3. Epithelioma of the cornea with pigmented stroma. By C. Devereux Marshall 117

IV. DISEASES OF THE CRYSTALLINE LENS.

1. Congenital misplacement of lenses; spontaneous dislocation into the anterior chamber; replacement of lens into the vitreous by operation; recovery of perfect vision. By Thomas H. Bickerton 118
2. On the pathogenesis of anterior polar cataract. (With Plate I.) By E. Treacher Collins 124

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ON

SOME OF THE CONGENITAL ANOMALIES OF THE EYE

AS ILLUSTRATED IN THE 'TRANSACTIONS' OF THE SOCIETY;

BEING AN

INAUGURAL ADDRESS

Delivered before the Ophthalmological Society of the United Kingdom on October 21st, 1897.

By Henry R. Swanzy, M.B., F.R.C.S.I.,
PRESIDENT.

Gentlemen,—In electing me to be President of this great Society you have conferred on me the highest honour at your disposal, an honour of which any one in our profession might well feel proud. In placing me here, moreover, you have added my name to a list which commences with William Bowman, and continues with Jonathan Hutchinson, John Whitaker Hulke, Hughlings Jackson, Henry Power, Argyll Robertson, and Edward Nettleship, names to be brought into association with which is in itself a high distinction. Again, in making me your President you have made me for the time the titular head of the profession of ophthalmology in these countries, and I may say in Greater Britain also, for our

membership extends to most of those who practise ophthalmology in India and the colonies. And when I remember the great men who in years now long gone by were the pioneers of that profession, and of the no lesser men who in more recent years added by their good work to its fame and reputation ; when I think, too, of the many able and well-known men who fill the ranks of that profession at the present time, I feel that to be its titular head is indeed a distinguished position.

These considerations, or any of them, would be enough to render this office one which might well satisfy ambition. And yet, gentlemen, its greatest charm is to be found in something else. The greatest charm of this office for me, as it has been for those who have gone before me, and as it will be for those who may follow after me in the long vista of future years,—the greatest charm of this position lies in this, that the constituency which elects to it is composed of the very men, the fellow-workers, the special colleagues, who must be deemed the most competent to discern whatever of good there may be in any of their brethren. That being so, why your choice has fallen on me I know not. Nor is it for me to criticise your action, even could I do so dispassionately. My duty is a pleasanter one, for it is to thank you most gratefully for your goodness and generosity to me ; and were I to give you an all-night sitting, I could not say more than that I thank you with all my heart.

One word more before I leave this part of my address. There is a point of view from which, without egotism, I can sincerely rejoice at the selection you have made ; for that selection shows for the second time, in the same marked manner, that this Society is conducted in no narrow spirit of metropolitan exclusiveness, but rather in that wider and wiser spirit, which recognises at least the possibility of there being some merit to be found outside the four-mile circle.

I should be glad to close here, gentlemen, and to allow

the Society to proceed with the other agenda of the meeting, which include some important communications. But it has been customary for an incoming president to devote part of his opening address to the consideration of some subject of professional interest, and I am not prepared to assume the responsibility of breaking away from this custom. At the same time I confess I think that in these days, when there is so much bad writing and so little good reading, an introductory presidential address is apt to promote the former vice, for its intrinsic difficulties are well-nigh insuperable.

I propose this evening to pass in short review some of the congenital anomalies of the eye as illustrated in the 'Transactions' of the Society. I had hoped to draw attention to most, if not to all, of the communications which have been made in this department, but I soon found that this would be impossible within the compass of my address, and I shall therefore confine myself to congenital anomalies of motions of the eyeball, coloboma of the iris, and a unique case of microcephalus and proptosis.

An exceedingly interesting class of communications in our 'Transactions' are those which treat of—

The Congenital Anomalies of Motion of the Eyeball.

These are of two kinds,—the so-called associated motions of the eyeball, and the congenital defects of motion of the eyeball.

Of communications which treat of associated motions of the eyeball, there is one by Mr. Marcus Gunn (vol. iii, p. 283), one by Mr. Browning (vol. x, p. 187), and two by Dr. Sidney Phillips (vol. vii, p. 306).

Mr. Marcus Gunn's case was a remarkable one. In it there was ptosis of the left eyelid, but when the external pterygoid of the same side was put in action, as in the act of chewing, the relaxed levator contracted, and the left lid was raised quickly and powerfully, this position being maintained so long as the jaw was kept drawn to

the right. Notwithstanding the ptosis, the patient could but imperfectly close the eye. The committee of experts appointed to examine Mr. Gunn's case consisted of Dr. (now Sir William) Gowers, Dr. Stephen Mackenzie, Mr. Lang, and Dr. Abercrombie. They reported their opinion to be that the levator was innervated both from the third nerve nucleus, and from the external pterygoid portion of the fifth nerve nucleus. Inasmuch as innervation of the levator was imperfect, the committee held it might be assumed that some of the fibres of the levator palpebræ portion of the third nerve arose not from the third nerve nucleus, but from the fifth nerve nucleus. This would explain the action of the levator in association with the external pterygoid, as well as the ptosis. The fact that the levator did not relax perfectly when the eyelids were closed might, the committee thought, be accounted for by its partial innervation from the fifth nerve nucleus. This theory of the case seems a reasonable one,—it is, at the least, the best working hypothesis out of several which have been offered; and an hypothesis we must have, so long as we have no means of attaining a definite knowledge of the cause. I know of only one other case of precisely the same kind on record (Schapringer, 'New York medicinische Monatsschrift,' January, 1892), although there are a good number of cases reported in which not merely with lateral motions of the jaw, but also with certain other motions of the jaw, the drooping eyelid was violently raised.

In Mr. Browning's case, when the patient looked either to the right or to the left, the upper lid of the side towards which he looked drooped, while that of the opposite eye became slightly elevated. On convergence both upper eyelids were raised above the horizontal. In short, contraction of either external rectus was accompanied by drooping of the upper eyelid of its own eye, while contraction of either internal rectus, in lateral motions or in convergence, caused elevation of the upper eyelid of its own eye.

Dr. Sidney Phillips's two cases were brothers. In them, on looking to either side, it was the upper lid of the eye away from the side towards which the eyes were directed which drooped to almost complete ptosis, while the upper lid of the other eye remained raised. Dr. Phillips thought that there was here an unusually close commissural connection between the nuclei of origin of the two third nerves, as a consequence of which simultaneous relaxation of the internal rectus and of the levator palpebræ superioris took place, instead of relaxation of the former alone. In the 'Ophthalmic Review' for October, 1895, there is a paper by Mr. Walter Sinclair on "Abnormal Associated Movements of the Eyelids," which is well worth reading, and in which the author gives a *résumé* of all such cases published up to that date, and to these he adds five hitherto unpublished cases.

In the foregoing cases we see there was no want of power in any of the orbital muscles. We now come to the other class of cases in our 'Transactions' in which such want of power is the leading feature. Of these there is one by Mr. Mackinlay (vol. vii, p. 281), five by Mr. Lawford (vol. viii, p. 262, and vol. xii, p. 172), one by Mr. Donald Gunn (vol. xiii, p. 150), and one by Mr. MacLehose (vol. xvi, p. 299).

Mr. Mackinlay's case was one of complete paralysis of each external rectus. The position of each eye was convergent, and there was no diplopia. It is not stated whether or not there was binocular vision in any part of the field.

Mr. Lawford's four cases, which appear in a valuable paper in our eighth volume, were a father, one son, and two daughters, out of seven children. In the father there was complete bilateral ptosis, no upward and very little downward motion in either eye, restricted lateral motion, and no action of the obliques. The interni acted better for convergence than in lateral motions. In one of the children there was complete bilateral ptosis, and no upward or

downward motion of the eyeballs. The usual position of the eyeballs was conjugate deviation to the right. On an attempt to look up the eyes were turned inwards, and the vertical axis rotated outwards. On an attempt to look downwards slight outward movement was produced, but without rotation of the axis such as would accrue from action of the superior oblique. There was moderate outward movement of both eyes, and convergence was possible to some extent. The most extraordinary effect was produced when he was told to look to the left, for then, while he did succeed in turning his left eye outwards, its fellow, instead of turning inwards, turned outwards also; in short, both external recti were thrown into action simultaneously. This meant, as Kunn points out, that the muscles were normal but the co-ordination of the motions deranged. In another child there was almost complete bilateral ptosis, and complete loss of upward motion in both eyes. In the right eye the lateral motions were fair, and there was slight downward motion. In the left eye there was slight inward motion, no outward motion, and no downward motion. The power of convergence was fair. In the third child there was complete bilateral ptosis, total want of upward and downward motion, and no lateral motion either conjugate or separate, yet there was a moderate amount of power of convergence. On an attempt to look either up or down slight convergence was produced. There was no diplopia in any of these cases, but there is no statement as to whether binocular vision in any part of the fields was present. In none of them was there any other congenital defect in the system.

Mr. Lawford quotes several writers on the subject, amongst others Heuck, whose cases were very similar to his own, and in one of which a post-mortem was obtained. This post-mortem showed that the orbital muscles, with the exception of the internal recti, were all inserted into the sclerotic in abnormal positions. In addition to this displacement, nearly all of the muscles were too short,

but, with the exception of the internal recti, they were well developed. The orbital nerves were in all respects normal.

Mr. Lawford says the abnormality, both in length and in the sites of their insertion, which the ocular muscles may present in these cases renders it impossible to give any reasonable explanation of the curious movements noticed in some of them, such as the rotation of the eye which occurred in his second case, when presumably the internal rectus alone should be acting. Dr. Carl Kunn, in his admirable monograph ("Die angebornen Beweglichkeitsdefecte der Augen," p. 45, Deutschmann's 'Beitr. zur Augenheilk.,' Heft xix, 1895), offers the following explanation of this phenomenon in Mr. Lawford's case:—In the normal upward motion of the eyeballs the superior rectus and the inferior oblique become innervated. In Mr. Lawford's case the superior recti were powerless, but the inferior obliques were active, as were also the internal recti. A desire to look up produced a nervous impulse which could not be expended on the defective superior rectus, and therefore it was concentrated on the normal muscles, hence the convergence (action of the internal rectus) combined with outward rotation of the corneal axis (action of the inferior oblique).

In our twelfth volume Mr. Lawford records another congenital case in which there was ptosis on the left side, the eyeball being divergent and rotated down. The right eye was normal. He noted that when the right eye was covered the left eye came to fixation by an upward and inward motion. The eye could be turned inwards almost fully, but upwards only to the horizontal position. When the normal right eye was screened and the left was turned up to the utmost, the right eye, under the screen, was found to be rotated upwards in an extreme position. There is no statement as to the presence or absence of the power of convergence, or of binocular vision. Mr. Lawford diagnosed a defect of the superior and internal rectus of the left eye, and slight defect of the

levator palpebræ, and proposed to tenotomise the inferior rectus and to advance the superior rectus.

Mr. Donald Gunn narrates the cases of two brothers with almost complete ophthalmoplegia externa, slight power of upward and downward motion being the only one present. There was incomplete ptosis.

Mr. MacLehose describes a case of paralysis of the left external rectus. In the same eye the inward motion was not perfect, while the upward and downward motions were full. The right eye was normal. When the patient looked to the right a phenomenon occurred which, so far as I know, is unique. The left eye became retracted into the orbit to such an extent that a clear intervening space was left between the globe and the posterior surface of the lower lid at the outer part, while the palpebral fissure became narrowed by contraction of the orbicularis. Mr. MacLehose adds, "Although I have spoken of paralysis of the sixth nerve, yet it is quite possible the limitation of movement may depend on an anomalous nerve distribution, or possibly an absence of the muscle itself. I can offer no satisfactory explanation." In the discussion which followed, Mr. Holmes Spicer mentioned a case under his care, in which the right eye was on a higher level than the left, and when the patient looked to the left the right eye went completely upwards. There was disturbing diplopia, and it was decided to divide the superior rectus. The insertion of the tendon was not found in its normal position, but far to the outer side towards the external rectus. If the same abnormal attachment had been present in the inferior rectus, Mr. Holmes Spicer said the effort of both muscles acting together would doubtless have been to pull the eye backwards into the orbit, and he suggested that some such arrangement may have existed in Mr. MacLehose's case.

We should like to know what the nature of the congenital lesion may be, which causes these defects of movement of the eyeballs. Besides Mr. Holmes Spicer's

case, and Heuck's case, quoted by Mr. Lawford, there are many others in the literature, both before the date of Mr. Lawford's papers and since then, in which, mainly during operations designed to correct the defect, or else post mortem, irregularities in the musculature of the eyeball were found, which were adequate to account for its defective mobility ; and Mr. Lawford, too, states that, so far as published records go (up to 1888), these defects of motion are almost always due to developmental anomalies affecting the ocular muscles, which are found to be either quite absent or ill developed, too short, or abnormally inserted, and that, except in cases in which there is gross defect in the nervous system, the nerves supplying these muscles have not been found at fault. This, he also says, is the opinion expressed by our standard text-books ; in fact, but few authors mention the possibility of absence or incomplete development of these nerves. Well, I am not myself prepared to give place to anyone in my profound respect for text-books on diseases of the eye, whether standard or otherwise, and I see some gentlemen here this evening who will join me in this attitude of mind. I am, therefore, glad when I hear a kind word said for the text-books. It is more common—indeed, it is quite common—to hear it stated "this or that is not mentioned in the text-books ;" and even our friend Mr. Lawford, who called the text-books to witness for him, could not completely emancipate himself from the phrase. The text-books notwithstanding, it is certain that while many of these cases are due to irregularities in the orbital muscles, they are not by any means all due to them ; for instances of congenital motor defects of the eye are on record in which those muscles were found to be absolutely normal in every particular. We are then, in such cases, thrown back on the nervous supply for the cause. Moebius, Siemmerling, and other distinguished neurologists regard an intra-uterine atrophic degeneration of the nuclear origins of the nerves as the primary cause, and in those cases where

orbital muscles are imperfectly developed, or wholly wanting, such authors ascribe their condition as a consequence of the nuclear alteration.

But nuclear degeneration has been actually found in but one case of Siemmerling's, and even that one is open to criticism. In a case of Uhthoff's the nuclei were found to be absolutely normal. It is true that in but a few cases was the opportunity offered of a microscopical examination of the nuclear region.

As regards the trunks of the nerves, I know of no observation indicating them as the site of the lesion ; but we may not yet dismiss from our minds the possibility of its occasionally being there. That the lesion may be in the cortex, or in the path between it and the nuclear centres, will have to be considered in any case in which muscles, nerves, and nuclei are found normal ; and the evidence to hand shows that such cases are likely to present themselves. There are many exceedingly important points in connection with the diagnosis of these congenital defects of motion, which the time at my disposal will not permit me to go into. Anyone who is interested in the subject should read Dr. Carl Kunn's monograph, which I have already mentioned. But I may be permitted to refer to one or two peculiarities of these defects of motion—it is hardly correct to call them paralyses. Take one of the most common and simplest cases—congenital loss of power in the external rectus. In acquired paralysis of the externus the eye is invariably found convergent; this is not always so in congenital loss of power of the external rectus, for the eye is often found, in the primary position, to be quite straight. In such a case, too, if the good eye be covered and the patient be required to look towards an object to the side of the affected eye, he of course cannot rotate the latter in the desired direction ; but it will be found that the covered eye too has not moved in that direction, as it would do in the case of an acquired externus paralysis. No conjugate motion of the eyes towards this side having ever

been acquired, the sound eye in this experiment had no incentive to direct its visual axis towards the object, once it had been deprived of the power of seeing the latter. As soon as it is uncovered, it is directed straight at the object, and then it will be found there is no tendency to over-action in its internus, as there would be in an acquired case. Again, in some cases of bilateral loss of power in the externus, but without loss of power in either internus, the eyes will not be moved from side to side at all, the interni never having learned to be associated with the externi in this action, although the interni do act together to bring about convergence. Furthermore, even in cases of congenital loss of power in each external rectus, there may be parallelism of the optic axes, and not convergence.

I shall now pass on to the papers on

Coloboma of the Iris.

In Mr. Arthur Benson's case (vol. iv, p. 351) there was coloboma of the iris below in one eye, a bridge of iris tissue connecting its pillars halfway down. There was also a coloboma in the lens corresponding to that in the iris, and a coloboma of the chorioid.

Mr. Phillips's case (vol. xi, p. 219) was one of complete coloboma of the iris in the right eye, with a small coloboma of the chorioid and lens, and cataract. The left eye was of small size, and in it there was incomplete coloboma of the iris, and a large coloboma of the lens, which was partially opaque. There was also a large coloboma of the chorioid, and of the macula lutea.

In Mr. Doyne's case (vol. xi, p. 220) there was coloboma of the iris and chorioid, with a curious bulging of the corresponding part of the lens.

Mr. Work Dodd (vol. xiv, p. 210) gives a case of coloboma of the iris and chorioid in one eye, which was of small size, with remains of the hyaloid artery. The iris coloboma was downwards and inwards, and was

incomplete, there being some fenestrated iris in the angle of the cleft. There were some remains of the pupillary membrane. Except in the coloboma the reaction to light of the pupil was good, but it did not react on accommodation. There was a large chorioidal coloboma below, which included the optic disc.

Mr. Lang in vol. x (p. 106), and Mr. Treacher Collins in vol. xiii, give us important papers on one and the same case. The patient was under Mr. Lang's care. He was aged 36, and was almost blind from glaucoma in each eye. In the right eye there was a coloboma of the iris. The lens was notched opposite the coloboma. Mr. Lang mentions that Manz lays stress on the fact that the fœtal iris, unlike the chorioid, has no cleft, and consequently cannot retain one, and that Manz points out that where, as in a case of his, a chorioidal coloboma is found on the temporal side as well as on the nasal side, some explanation other than the failure to close the fœtal fissure must be sought for, and Mr. Lang thought Deutschmann's hypothesis of an intra-uterine inflammation becomes applicable in many cases. The glaucoma in this eye, Mr. Lang said, was difficult to explain, the theory that an iridectomy is a safeguard against glaucoma being apparently negatived by it. A possible explanation, he thought, might be, that the trabecular tissue constituting the spaces of Fontana may have been absent in this case at the coloboma, and the available space for filtration of lymph would therefore have been smaller here than in a normal eye, and hence the liability to glaucoma greater.

This eye subsequently became painful, and Mr. Lang was obliged to excise it, and he gave it to Mr. Treacher Collins for pathological examination. Mr. Collins found the iris absent on the outer side, but the ciliary body was present in that position. On the inner side the root of the iris was in contact with the posterior surface of the cornea, blocking the filtration angle. The case, Mr. Collins said, presented several points for consideration.

Firstly, the unusual position—namely, outwards—of the iris coloboma. It is frequently, and Mr. Collins thinks wrongly, assumed that a congenital deficiency in the iris must necessarily bear some relation to the ocular cleft. But in another remarkable paper on irideræmia in this same volume (vol. xiii, p. 128) Mr. Collins showed that the development, not merely of a part of the iris, but of the whole of that organ, may be arrested by abnormal adhesions or late separation of the cornea and lens preventing the in-growth of the iris ; and if this abnormal adhesion or late separation happen to be confined to a portion of the circumference in one, or even in two, directions, a coloboma, or even two colobomata, might be produced in any direction.

The occurrence of glaucoma in an eye with congenital iris coloboma is remarkable. But here at the coloboma there was a rudimentary iris, as also in Mr. Collins' case of aniridia, which was intimately adherent to the ligamentum pectinatum, and Mr. Collins is of opinion that this adherence was congenital. It then only remained for the root of the iris in the rest of its circumference to become pushed forwards in order to bring on high tension. Mr. Collins states he does not agree with Rindfleisch in ascribing intra-uterine inflammation beginning in the chorioid and extending forwards, and causing perforation near the corneo-scleral margin and escape of aqueous, as the primary cause of the abnormal contact. In his specimen no sign of perforation was present. Again, the corneo-scleral margin is an unusual seat for a perforation. Furthermore, it is unlikely that a bilateral condition, such as aniridia usually is, would be caused in this way. And, finally, it is unnecessary to resort to this explanation, for at the period when the iris is developing there is no anterior chamber, and hence the lens-capsule and the cornea are in contact, the anterior fibro-vascular sheath alone intervening.

In these papers we have examples of Mr. Treacher

Collins' admirable pathological work, and it affords me much pleasure to take this opportunity of saying that highly as that work is valued by us in this country, and especially in this Society, it is esteemed, as I very well know, equally highly in another country, where pathological anatomy is, perhaps, more at home than with us. It was, therefore, not without a pang of regret that I, for one, heard of the translation of Mr. Collins from the post where he did such good and useful work, to another, which we hope will lead him on to fame in a second direction.

And now, in conclusion, I desire to direct your attention to a remarkable case of Mr. Henry Power's, in vol. xiv (p. 212), under the title of—

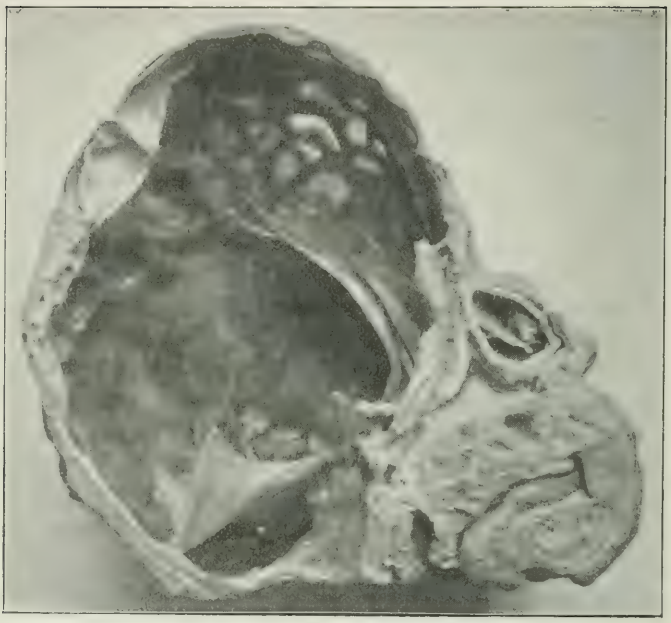
A Case of Microcephalus and Proptosis.

The case was that of a female child born at full term after an easy delivery, and you will remember the remarkable picture given of the infant's face and head. It died when about a month old. The head was misshapen, and the eyes were both projecting to so great an extent that the margins of the lids were far behind the equator of the globes. The globes could not be pushed back, but the eyelids could be pulled forwards, and made to meet in front of the eyes. The head was very short in the antero-posterior direction, but of considerable height, especially in the frontal region, where it became cone-shaped. After hardening in spirit a sagittal section of the head was made, passing through the vertical meridian of the right cornea. The right orbit, which was thereby opened, was found to be extremely shallow, its depth being only 2·5 cm. from its inferior border to the optic foramen. The height of the orbit, on the other hand, was increased, measuring 32 mm. at its most anterior part, while 20 mm. is the normal measurement at this period. The corpus callosum was absent (and not present, as stated in the communication), and in certain localities the surface of the brain presented a

microgyrous condition. After removal of the brain a photograph of the skull was taken by Prof. D. J. Cunningham, professor of anatomy in the University of Dublin, who like myself was much interested in the specimen. The floor of the orbit was horizontal, but the roof was almost vertical in position, being directed upwards and forwards at an angle of 45°, and becoming continuous with the vertical plate of the frontal bone, into which it passed with only a small projection to mark the orbital edge. A perpendicular line from the front of the vertical portion of the frontal bone would fall entirely behind the globe. The optic nerve from its entrance at the optic foramen ascended sharply, and remained in close relation with the displaced roof of the orbit, till it bent downwards to enter the sclerotic. A complete explanation for these extraordinary conditions is not given in Mr. Power's communication, and as I was particularly desirous to have one for a special purpose, I applied to Dr. Kanthack, late curator to the museum of St. Bartholomew's Hospital, and he in the kindest manner lent me the specimen for further examination, and I then submitted it for that purpose to Prof. Cunningham. He ascertained that, with the single exception of the joint between the ex-occipital and the basi-occipital, every suture and synchondrodial joint in the skull was firmly ossified. The consequence of the solidification of the base, and the ossification of the vault into a continuous bony sheet, was the general uplifting of the front part of the roof of the cranium by the growing brain, and the simultaneous dragging up with it of the orbital plates, to which latter is due the extreme shallowness of the eye sockets.

It was also found, that the convolutions of the brain had pressed so hard against the ossifying cranial vault, that the normal dimples had become deep bony pits, and the floors of these pits had become exceedingly thin and diaphanous.

The accompanying illustration supplements those given by Mr. Power in his paper.



The case affords a valuable instance of the effect of premature synostosis in producing such deformities, and their resulting displacements of the eyeballs.

ON THE

ETIOLOGY AND EDUCATIVE TREATMENT OF CONVERGENT STRABISMUS.

BEING

THE BOWMAN LECTURE,

Delivered on Friday, June 10th, 1898,

By Priestley Smith,

PROFESSOR OF OPHTHALMOLOGY, MASON UNIVERSITY COLLEGE, AND OPHTHALMIC SURGEON, QUEEN'S HOSPITAL, BIRMINGHAM.

Mr. President and Gentlemen,—We are met to do honour to the memory of William Bowman. To me, and probably to others here present, it seems but a very little while since Sir William Bowman was amongst us as the President of this Society; interesting himself in its success; giving to it, from the beginning, something of his own dignity and high position; guiding its discussions with that combined authority and simplicity which those who knew him are not likely to forget. Some of us looking back a little further recall him as he used to be at Moorfields,—the quiet keen observer, the thoughtful teacher, the perfect operator; a leader among those, all well remembered, who were the leaders of those days.

But the greater part of Bowman's career belongs already to the region of history. He came to London and to King's College in the first year of the Queen's reign. Within the next few years he published those

researches in physiology which brought him early fame and a Fellowship and medal of the Royal Society. He became surgeon to the Moorfields Hospital in the very year which saw the birth of the ophthalmoscope, and in the same year formed that close friendship with von Graefe and with Donders which it is so interesting to recall. The most inspiring pages in the history of ophthalmology, I think, are those in which Donders tells the achievements of Graefe and of Helmholtz, and those others, written a few years later, in which Bowman does honour to the memory of Donders.

Going still further back, I may claim for my own city of Birmingham a close connection with Bowman's early life. He received most of his schooling at the old Haslewood School; a model of the schoolhouse made by his clever hands stands to this day in the library of a fellow scholar, now one of our oldest citizens. He chose his profession there, and entered it by apprenticeship to a Birmingham surgeon. He began his work with the microscope, and his fruitful study of pathology at the Birmingham General Hospital. In after life he recalled these old associations in a very generous manner.

To be appointed Bowman Lecturer to this Society is a great honour, and always will be; to me, remembering Sir William Bowman as I do, it is this and a great deal more, and I am deeply grateful to the Council for giving me the privilege.

For the cure of strabismus, measures of three kinds are employed at the present day: optical, operative, and orthoptic, or, as I should prefer to say, *educative;* the aim of this educative treatment being to lead the patient not merely to *direct* his eyes, but to *use* them, in the normal way; to teach him the forgotten art of binocular vision. We combine these several lines of treatment variously according to the nature of the case before us, and our own individual estimate of their value.

The importance of optical treatment in a large majority of cases is admitted by all. Thanks to Donders we know that the common forms of strabismus are very frequently dependent, to a certain extent, on errors of refraction, and that a continuous use of correcting glasses will usually diminish the squint, and sometimes banish it completely. Atropine and the shadow test enable us to prescribe glasses correctly even for young children, and the difficulty of getting them worn is less than it was a few years ago. The average parent now knows that the child who squints is probably in need of glasses, and often expects even more benefit from them than they are capable of giving.

Again, the value of *operative treatment* in a large proportion of cases is beyond question. It is true that the original operation introduced by Dieffenbach nearly sixty years ago, and very widely practised by him and others for some years, gave many bad results and fell into disrepute. That was inevitable; for not only was the operation faulty in method, but it was employed as the sole treatment, without knowledge of the underlying optical conditions. But all that is changed. Operation is now usually a supplement of other treatment, and the technique is greatly improved. We still differ, no doubt, on points of detail, but the differences are not fundamental, and the results now commonly obtained by operation are excellent as far as they go.

The *educative treatment* of strabismus, that is the systematic use of the monocular shade, the reading bar, the stereoscope, and so forth, stands on a different footing. Javal,* the chief exponent of this system, who has used it for many years and elaborated it with infinite ingenuity, declares that it is not only an important auxiliary before and after operation, but is capable by itself of curing certain cases. Other well-known authors, among them our President in his admirable handbook, advise exercises in certain cases; some members of this Society have

* 'Manuel du Strabisme,' Paris, G. Masson, 1896.

employed them, I believe, for years past; we most of us possess a stereoscope; but, unless I am mistaken, there is at present no general agreement as to the value of this line of treatment, and no very general employment of it; indeed, one well-known writer goes so far as to doubt whether the cases which have been cured by it would not have got well without it, and whether those which are incurable without it, are ever curable with it.

What is the value of the educative treatment of strabismus? That is the main question which I desire to raise. Until about two years ago I had myself attempted little in this direction. Since that time I have studied it so far as time and opportunity would permit, and in so doing have received help from Dr. Javal, which I desire here gratefully to acknowledge, especially his kindness in showing me his methods and many of his cases during a short visit to Paris in the early part of last year. The experience gained even in this short time is certainly of value to myself, and may, perhaps, be of some use to others.

There are, of course, cases of squint in which binocular vision is recovered without special exercises of any kind, and others in which it is irrecoverable by any means whatever. The debatable ground lies between these extremes. The object I had in view was not merely to try certain methods in a few selected cases, but to obtain, if possible, some classification of cases according to causes, age, course, and other characters which should be a guide to the use of these methods. It was easy to find ample material for investigation; not easy to deal with it adequately; for the points in which cases differ from each other, and the pitfalls which beset the unwary observer, are very numerous. Since January 1st, 1897, all cases of concomitant convergent strabismus coming under my care, including a few the treatment of which had begun earlier, were examined by myself and noted on special printed forms.

Permit me briefly to review the methods of examination.

At the first visit the following points were noted: the age; the age when the squint began, if ascertainable; the circumstances of the onset, if any, were clearly stated. Then the nature of the squint, whether periodic or continuous; if continuous, whether alternating or monolateral. Thirdly, the fixation power of the squinting eye as tested by the ophthalmoscope and corneal reflex. If the patient, with his good eye well covered, could fix the mirror correctly with his squinting eye, "*true* fixation" was noted; if not, "*false* fixation." Lastly, the angle of the squint was measured by the tape.* The measurement occupies only a few seconds, and presents little difficulty even in young children. The tape I now use measures 60 cm. in length instead of 1 m. as formerly. (The tape method assumes concomitancy; where this is not complete it involves an error, but not to an extent which affects the present question. The measurements obtained with the tape are not exactly comparable with those obtained when the eye fixes a distant object. Maxwell found the angle of the squint to be on the average 2 degrees greater in fixing a point at ·25 m. than in fixing a point at 6 m.†) This done, atropine was ordered.

At the second visit, the eyes being under atropine, the refraction of each was determined by means of the shadow test, supplemented, when possible, by use of the test types. Then, with corrected refraction, the acuteness of vision was ascertained when possible. In presence of important ametropia, spectacles, to be worn constantly, were ordered. Those for whom glasses were ordered were examined thereafter, whether as to acuteness of vision, angle of deviation, or what not, always in their glasses, unless otherwise noted.

While the eyes were under atropine any obvious faults in the media were noted. I had intended to note the condition of the fundus also, but soon abandoned the attempt on account of the great additional labour it

* 'Ophthalmic Review,' vol. vii, p. 349, 1888.

† 'Brit. Med. Journ.,' Sept., 1896, p. 818.

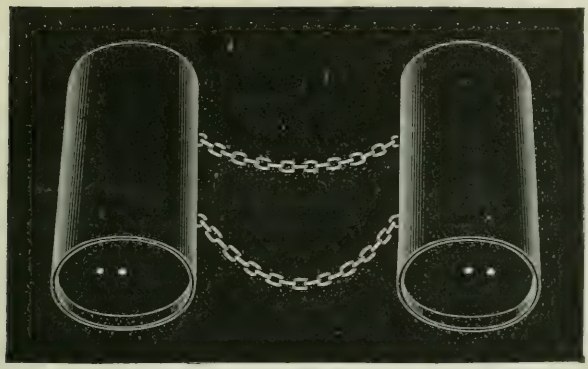
entailed. So far as it went the routine examination of the fundus gave almost entirely negative results. Heredity was not investigated, but it was observed in many cases.

Up to this point the observations related chiefly to the origin of the squint and to the conditions present when treatment was begun. Re-examination from time to time showed the progress and the effects of treatment. Beyond this there were certain tests, employed chiefly in the later stages, which I must describe more fully. They were concerned mainly with the presence or absence of the faculty of fusion.

First as to *fusion-sense*, *i.e.* the potential faculty, as distinguished from the actual habit, of fusion. The squinter, looking at an object such as a lighted candle, sees it single rather than double, because he has learned to take no notice of the image in the squinting eye. Will he be able to perceive both images simultaneously and to fuse them if we succeed in putting his eyes approximately straight? The only way in which we can test the point beforehand is by taking two similar objects and placing them so that while the straight eye fixes the one, the squinting eye fixes the other, and so that each eye can only see its own object, as in the stereoscope. This small instrument (Fig. 2), which for convenience I will call the "fusion-tubes," is essentially a miniature stereoscope, admitting of free adjustment for abnormal positions of the eyes. Two short tubes are held together by chains which permit movement in any direction. At one end of each is a biconvex lens; at the other a shutter provided with a small round hole at the centre, covered by a piece of ground glass. The distance between lens and shutter equals the focal length of the lens, so that the emmetropic eye looking through the lens sees the hole with relaxed accommodation, as though it were a distant object. Holding the tubes in a divergent position before my own eyes I see the two holes at some distance apart, and now, making them parallel, I see only one, for the

two images are fused. Some persons who habitually squint can fuse these images, either at once or after a

Fig. 2.



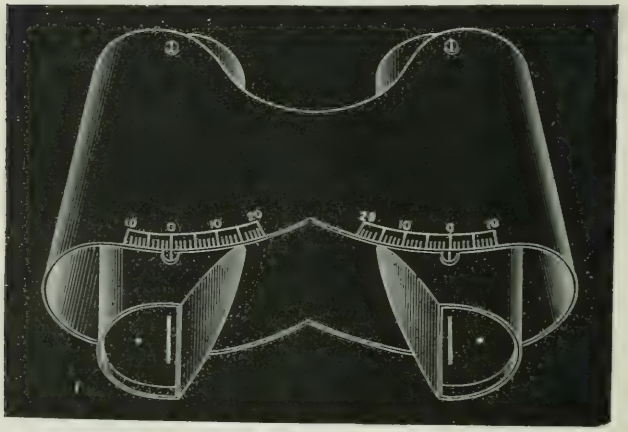
Fusion-tubes.

little practice, by bringing the tubes into a convergent position. Others cannot do so. But it will strike you that, in using such an instrument, the squinter who declares that he sees the two holes as one may be using only one eye. For the avoidance of that fallacy each shutter is provided with a second hole a little to the outer side of the central one, and this second hole is coloured by a film of celluloid, red in the one tube, green in the other. Now the squinter who, at first view, sees four holes—two white, one red, and one green—and then by converging the tubes joins the two whites into one while he continues to see the red and the green, has, we may assume, a potential faculty of fusion, although, under ordinary circumstances, he is unable to exercise it and cannot even be made to perceive the two images of one object.

Now as to the *limits of this fusion power*. The patient, we find, is able to fuse the two images when the tubes stand at a certain angle of convergence. Can he vary that angle and still fuse them? Can he voluntarily

abduct or adduct his eyes in the interest of binocular vision, and if so, within what limits? The fusion-tubes can only give rough indications on this point. For the purpose of accurate measurement I have placed them in a frame (Fig. 3) which supplies fixed points of rotation,

Fig. 3.



Heteroscope.

with scales showing their angular movement. Moreover, the central hole in each shutter is replaced by a narrow vertical slit, so that in cases where the deviation is not strictly horizontal, fusion may still be attained by a vertical overlapping of the slits. Having placed the tubes in a position which enables the patient to fuse the white lines, we very slowly move one or other, first outwards, then inwards, and note the point in each direction at which he is unable to maintain the fusion of the lines, and sees them double. In this form, therefore, the instrument can test not only the presence of fusion power, but its angular limits.

In certain cases, especially those which appear to be nearly or completely cured, another question suggests itself. What position do the eyes assume when the

Note relating to the Heteroscope.

The centres on which the tubes rotate are at a fixed distance from each other (60 mm.), and it might be supposed that when the distance between the eyes is greater or less than this the instrument would give false readings as to the directions of the visual axes. But this is not so. Apart from a minute error depending on spherical aberration, it is immaterial whether the eyes stand exactly opposite to the axes of the tubes or somewhat excentrically, for, since the source of light is in the principal focus of the lens, the rays issuing from the lens are parallel with the axis of the tube,—that is to say, the direction in which they fall upon the eye is the same whether the position of the eye be centric or eccentric.

stimulus of fusion is withdrawn? What is their *angle of equilibrium?* In other words, is there any important heterophoria or latent squint remaining? To test the point by means of the same instrument we cut off, by means of a moveable shutter, the upper part of the one slit and the lower part of the other, so that the two images cannot be fused, and tell the patient to place the tubes so that the one white line stands exactly over the other. This is not a perfect test for heterophoria, for the patient may relax his convergence less completely than when tested with a distant object; still it is practically useful and easily applied. The instrument in this form, being distinct from the fusion-tubes, must, I suppose, have a distinguishing name. For want of a better I have called it a *heteroscope*, an instrument with which a deviating eye sees.*

The remaining tests were for the purpose of ascertaining whether actual fusion, that is binocular vision in looking at a single object, had been re-established. A completely satisfactory test of this point is difficult to find, and the more so because binocular vision is a faculty which presents various degrees of perfection.†

* The fusion tubes and heteroscope were made by R. Bailey, Bennett's Hill, Birmingham.

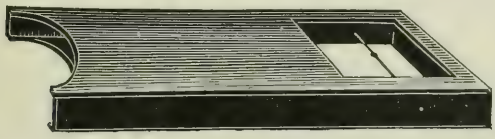
† The induction of diplopia by means of a prism is no proof of binocular vision, for there are many persons who do not fuse, and who do not see double under ordinary conditions, who yet perceive the second image the moment it is displaced to an unaccustomed part of the retina by means of a prism. The induction of compensatory movement to correct diplopia, by a prism held before either eye in turn, is good evidence of binocular vision; but it is difficult, in children especially, to make sure whether such movement does or does not occur. Again, the ability to read with a pencil or other object placed midway between the eyes and book cannot be tested in the case of young children and slow-minded persons, and is, moreover, no proof of fusion, for some patients with slight alternating squint can readily accomplish this "bar-reading," as we may call it, although they are entirely unable to fuse. Hering's drop test, and, still more, Berry's stereoscopic movement test, are too exacting for the patient who is only beginning to use his eyes in concert, for the faculty of seeing in perspective, of appreciating solidity, comes of long practice in forming visual judgments, and cannot be expected in those whose education in this art is only just beginning.

I decided to adopt as the initial test for actual fusion, the principle of Snellen's coloured glasses and coloured letters. Spectacles carrying red and blue glasses in a reversible frame, so that either colour may be placed before either eye, are placed on the patient's face in front of his own glasses. He is then shown, at reading distance, a card with three discs on a black ground, a white one in the middle, a red above it, a blue below. He is asked how many rounds he can see. If he can see all three at once and in a line, he is probably using both eyes, and fusing the two images of the white disc. Covering each eye in turn, we put the question again. If with each eye alone he sees two, but with both eyes three, we have a fairly conclusive proof. Still it is possible that he has learned by experience what answers will please the examiner and save himself further trouble, and that he frames his replies accordingly. On each disc, therefore, is a black letter, and these, if he knows his letters and has sufficient vision in the eye which formerly squinted, he must read. By using several cards bearing different letters, we can exclude this source of error. If we find, however, that he can see all the three discs with one eye only, we know that the colours do not neutralise each other, and this will sometimes happen if the card be viewed in too strong a light, especially if the pupils be large. On the other hand, on foggy days and in artificial light, the blue disc may be hidden even by the blue glass from a normal eye: the examiner must not expect the patient to see what he cannot see himself. Having proved the presence or absence of fusion at reading distance, we repeat the test at three or four metres, using larger discs. One other source of possible fallacy must be mentioned; the patient who appears to be using his two eyes simultaneously, may possibly be using them alternately; with good vision in both eyes and a facility for suppressing it in either, he may have a rapidly alternating squint, and no real fusion. In such cases the patient will confess that, though he can see the

three discs, he cannot see them all at once or in a straight line. He should be tested with the discs in a horizontal line as well as in a vertical. This test for binocular vision of an elementary kind seems to me to be a good one for practical purposes; it occupies not more than a minute or two, and is applicable to young children. A child too young to read, but able and willing to count one's fingers, one, two, or three, can by its means be tested for fusion with considerable certainty.

For the sense of perspective—the higher development of binocular vision which is learned by the continued practice of fusion—I used Hering's drop test.* This box is the instrument actually employed (Fig. 4).

FIG. 4.



Box for drop test.

These were the tests. Let us now turn to the results, and first to those which relate to *the causes and natural course of the disorder*. Remembering how carefully of late the etiology of strabismus has been studied by Hansen-Grut in his Bowman Lecture,† by Lang and Barrett,‡ Berry,§ Adams Frost,‖ Maxwell,¶ Holthouse,** and others in this country, to say nothing of what has been done abroad, one might well shrink from broaching the subject here; seeing, however, that our knowledge of

* See 'Brit. Med. Journ,' June 20th, 1896.

† 'Trans. Ophthal. Soc.,' 1890.

‡ 'Roy. Lond. Ophthal. Hosp. Reports,' vol. xii, pp. 7 and 133, 1888.

§ 'Edin. Med. Journ.,' Jan.—March, 1897.

‖ 'Brit. Med. Journ.,' 1887, vol. ii, p. 663.

¶ Ibid., 1896, vol. ii, p. 818.

** 'Convergent Strabismus,' London, Churchill, 1897.

it is still in parts uncertain, I make no apology for attacking it again.

The most conspicuous point in the etiology of convergent strabismus is *the early age* at which it usually begins (Table 1). Donders saw its onset mostly about the

TABLE I.—*Onset Age in general, and in relation to True and False Fixation* (261 *cases of Convergent Strabismus*).

Year of Life.	1st	2nd	3rd	4th	5th	6th	7th	8th	9th	10th	11th	12th	13th and over.	Total.
All cases .	16	31	38	63	35	36	9	11	8	6	2	1	5	261
True fixation .	13	17	26	50	27	31	8	11	8	6	2	1	5	205
False fixation	3	14	12	13	8	5	1	...	...	...	...	...	...	56

fifth year, and warns us against accepting reports of its appearance in very early infancy; but later observations, my own included, show that more cases begin in the fourth year than in the fifth, many in the third and second, and some even in the first. In my own cases the onset age was registered only when it could be fixed with some degree of precision, and in many instances I myself saw a squint already established in the first year or two of life. I do not attach a precise value to the figures in this table, but I would lay stress on the fact that *the disorder commonly begins at a time of life when the visual apparatus has hardly reached completion either in structure or function.* This is important in relation to our present inquiry. Let us look for a moment at the process by which normal vision is acquired in early life.

The much debated question whether the co-ordination of eye movements represents innate structure or acquired habit cannot be dogmatically answered. It is one of degree. Co-ordination is both innate and acquired, and variously so for different organs and different animals. The chick picks up grains of food within a few hours of

leaving the egg, and after a few false shots strikes them with precision. Here the co-ordinating mechanism is complete or nearly so before it is used. The human infant is far behind the chick in this respect. His faculties, destined ultimately to be of higher order, come to perfection more slowly. His first eye movements, though already co-ordinated structurally for bilateral action, are purposeless, like the first movements of the limbs.* They have no relation to external objects. They represent activity in the lower levels or centres of the brain, uncontrolled by perception in the higher.† The higher levels are still undeveloped. His vision at birth is a mere perception of light. Soon he begins to notice conspicuous objects, then to recognise and follow them, and by the end of twelve months he watches all that goes on in his neighbourhood. We cannot test his vision at this age, but it is certainly not yet acute. He will pay no heed to minute objects. Even when he is old enough to learn his letters these must at first be large, and unless I am mistaken, even when he is able to name them all, he will still for a time be found unable to recognise Snellen's No. 6 at six metres. During these early years, too, his refraction alters. Beginning with a considerable hypermetropia, like a lower animal, he gradually approaches emmetropia, but at six years of age has usually some hypermetropia still.‡ The visual apparatus with which the infant comes into the world is rudimentary; it is elaborated by use; the fine adjustments are made by practice and observation. The onset of strabismus in a young child involves an interruption and even a reversal of this process. What are the conditions which induce it?

The best known cause of strabismus is *hypermetropia*.

* W. Preyer, 'Die Seele des Kindes,' Leipzig, Grieben, 1884.

† See "Automatism and Control," in Lloyd Morgan's 'Comparative Psychology,' London, Walter Scott, 1894.

‡ B. A. Randall, "A Study of Refraction in School Children," 'American Journ. of Med. Sciences,' July, 1885 (p. 25 in reprint).

By explaining the nature of this defect and its relation to accommodation and convergence, Donders founded almost a new branch of science, and conferred immense benefit on the legions of hypermetropes who are always with us; but in this question of strabismus his teaching has, I think, by reason of its importance, dominated some of us too exclusively—at least that has been my case. When a squinting child has been found to have no hypermetropia, or worse, to persist in squinting when his hypermetropia is corrected, one has felt surprised, if not annoyed, that he should thus violate a great scientific principle. It would have been wiser to revise the limitations of the principle.

How far does convergent strabismus depend on abnormal accommodative effort? This question, raised many times since Donders wrote, is partly one of statistics, and must therefore be approached with special caution. A leading American authority declared only last year, on the strength of statistics, that strabismus depends "almost entirely on hypermetropia, with an exception that does not reach 1 per cent." I have tabulated 310 cases (Table 2), placing

TABLE II.—310 *Cases of Convergent Strabismus Refraction under Atropine.*

	No. of cases.		Per cent.	
M.	3	...	1	
E. to H. 1·5 D.	34	...	11	
H. 2·0 to 3·5 D.	106	...	34	
H. 4·0 to 5·5 D.	122	...	39	88
H. 6·0 and over	45	...	15	
	310		100	

them in five groups according to the refraction of the fixing eye. It is the fixing eye that determines the amount of accommodative effort. Astigmatic eyes, of which there were many, were classed with others according to their mean refraction; for, as Carl Hess has shown,* the astigmat does not, as was formerly supposed,

* 'Von Graefe's Archiv,' vol. xlii, pt. ii, p. 80, 1896. See 'Ophthal. Review,' Feb., 1897, p. 48.

adjust his accommodation intermittently for one or other of the chief meridians, but persistently for the mean of these, because in that way he obtains a better picture on his retina than in any other Thus an eye with H2 in one meridian and H4 in the other habitually accommodates as though it had H3 all round, and may for our present purpose be classed with hypermetropia of that amount. The influence of astigmatism on the acuteness of vision is of course a separate matter.

But such figures give no sufficient answer to our question. They show certainly that a very large majority of squinting children examined under atropine are hypermetropic, but this is true, as we have seen, of the large majority of non-squinting children also. We want to know not what percentage of squinters are hypermetropic, but what percentage are abnormally so. Where shall we draw the line? If we reject, from my own cases, all those of less than 2 D., we have 88 per cent. remaining. If we reject a somewhat higher grade we shall have a lower percentage, but still a large one. The figure has no definite value. This, however, we can safely say: that grades of hypermetropia which are exceptional among people in general, even in early life, are prevalent among those who squint. Clearly they predispose to the occurrence of squint, or actually induce it in certain cases. But we have to remember, on the other hand, that a considerable contingent of squinters have little or no hypermetropia, and that the vast majority of hypermetropes have no squint.

Before speaking of other causes I will ask your attention to a point which has perhaps received less consideration than it deserves—*the relation between the amount of the hypermetropia and the angle of the squint.*

Under normal conditions a given amount of accommodation is associated with a corresponding amount of convergence. The two efforts being habitually made together are to some extent inseparable, but not entirely so. The link is elastic. We can all of us dissociate the

two acts to some extent. The ordinary hypermetrope learns to regulate this association so as to meet the special requirements of his eyes; he acquires the habit of converging normally while he accommodates abnormally, and does so as a rule without much difficulty, for, as George Berry * has shown, the latent tendency to abnormal convergence in the hypermetrope is usually slight as compared with the amount of the hypermetropia. We might therefore expect that the exceptional hypermetrope who, as Hansen-Grut put it, is a *duffer* in this respect: who fails to acquire this necessary habit and squints instead, would present a deviation either proportionate to the amount of his hypermetropia, or falling somewhat short of it. But this is not so. The angle of the squint greatly exceeds that which the hypermetropia would seem to require.

This diagram (Fig. 5) exhibits the fact as observed in 239 cases. It shows, firstly, the normal direction of the two eyes when fixing a point 60 cm. distant, that being the distance employed in my measurements. Secondly it shows the positions which the one eye, on renouncing binocular vision, should theoretically assume while the other eye still fixes the same point with an excess of accommodative effort equal to 1, 3, 5, and 7 D. respectively. Thirdly it shows the actual degrees of deviation found in my four groups of cases.† You will see that although the actual deviation increases with the hypermetropia, it is not in proportion to it, low grades of hypermetropia being associated on the average with a deviation of as much as 22 degrees, while high grades increase it by only 8 degrees. The same discrepancy may be seen in the figures given by Holthouse. Maxwell specially refers to it.

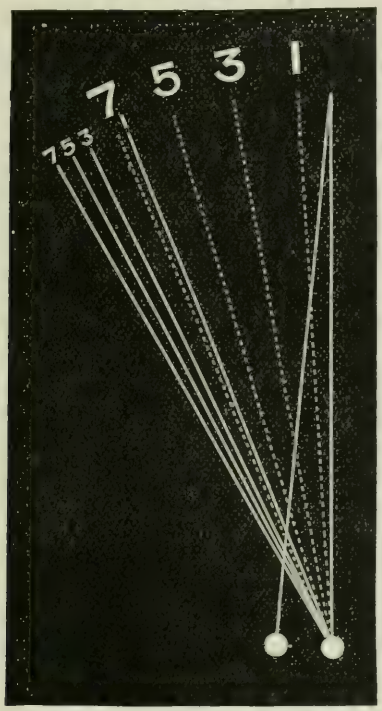
What is the explanation? Why does the hypermetrope when he squints at all, squint so much more than would

* Loc. cit. (p. 8 in reprint).

† The figures 1, 3, 5, and 7 are slightly higher than the mean refraction in my groups, but this only renders the discrepancy more striking.

seem to be necessary? Please observe that he does so not only when the squint is of long standing and may have

FIG. 5.



1 3 5 7. Angles corresponding to the hypermetropia.
1 3 5 7. Angles actually present.

led to secondary changes in the muscles and connective tissue of the orbit, but while it is still recent. Certainly the deviation increases with time up to a certain limit, but it is excessive very soon after it begins. Is it a voluntary and purposive act for the more complete avoidance of diplopia? This view has, I think, been commonly held, but it is not altogether satisfactory, for if the extra deviation were maintained by an effort of the will for the purpose suggested, it would surely be

abandoned to some extent when the squinting eye was covered, and would hardly occur at all when the squinting eye is comparatively useless; whereas it is sometimes these useless eyes that squint the most. Is it not rather the overaction of a motor centre which has escaped from conscious control? The maintenance of fusion depends, as we have seen, on brain action of a complex nature; on lower centres which act, when uncontrolled, without regard to purpose; and higher centres which control them. There are many conditions in which failure of the higher centres leads to overaction in the lower. Writer's cramp is a familiar example. In this disorder, as the control of the finer movements fails, the coarser actions of the hand and arm become exaggerated, until a violent overaction sets in which is not merely useless but prohibits use. In strabismus we have probably exhaustion of the controlling centres, and we have something more. Whereas the palsied writer continues to perceive most painfully his inability to control his hand, the squinter quickly loses the perception which should guide his eye. The sense of fusion falls into abeyance not by the mere withdrawal of one image, as when the eye is covered by the hand, but by a purposive inhibition or suppression of it. This suppression confirms the loss of control, and degrades the act of convergence to a purely automatic level.

The onset of strabismus is often attributed to a fit, a fright, a fall, or other such occurrence, and still more often to an illness, such as whooping-cough or measles. Making allowance for the frequency of such events among children, and for a certain disregard of time and sequence in their elders, it seems to me highly probable that these supposed causes are very often real causes. Some such explanation of the onset was given, with show of reason, in more than two fifths of my cases, and the proportion would no doubt have been higher had not many of the patients been brought by persons who knew nothing of their antecedents. In many cases the history was definite

and not to be upset by cross-examination. For example, a child who had never been seen to squint before, came from school squinting badly, having that morning been put into the corner with a cloth over her head; another did the same immediately after having his head pushed into a bucket of water by his brother; another after sitting in scalding water; another after being terrified by a monkey which jumped on to her shoulder. No less clear in many cases was the history of onset during measles, whooping-cough, or other constitutional disorder. All these are conditions which may gravely disturb the nervous system. Shock, anger, or apprehension impair the control of muscular action; they cause the knees to shake, the voice to tremble, and even the hand of the ophthalmic surgeon to become unsteady. Febrile disorders cause delirium, convulsions, and sometimes transient strabismus, and leave the nervous system exhausted. Is it not highly probable that such disorders occurring in young children may interrupt the action of those higher centres which control the movements of the eyes, and this not only where control is already difficult by reason of amblyopia or error of refraction, but even in children whose visual apparatus is normal for their time of life, but not yet fully developed?

Inequality of vision in the two eyes is an important factor in the causation of squint. When considerable, it lessens the value of binocular vision and increases the difficulty of maintaining it. It is due sometimes to disease or injury of the eye, but such cases are exceptional; the opacities of the cornea or other media on which most authors lay stress were found in less than 5 per cent. of all my cases. We have chiefly to distinguish between that inequality of vision which depends simply on unequal refraction in the two eyes, disappearing when this is corrected, and that which persists in spite of such correction.

As regards refraction, the squinting eye is frequently inferior to its fellow, having a higher degree of H., of As.,

or of both. Holthouse found equal refraction in only one seventh of all his cases; I, to my surprise, found it in nearly one half. Probably I overlooked differences of 0·5 D. or more in many cases, especially among the younger children, but I feel safe in saying that anisometropia sufficient in itself to seriously depreciate the value of binocular vision is not a very prevalent condition. On the other hand, an inequality of vision not removable by correction of the refraction is very common. Among cases in which vision could be tested it was present in 78 per cent., slight in some, but considerable in a large number; in 23 per cent. of all my cases the squinting eye had no power of true fixation.

What is the nature of the amblyopia in the squinting eye? Is it a cause or a consequence of the squint? Donders attributed it to progressive loss of vision through habitual suppression. Javal still adheres to this view. Schweigger * and, following him, many others, regard it as a congenital defect which precedes and in large measure causes the squint. There is little evidence to show that an eye which has once acquired good vision can lose it through squinting. Were this the case we should expect to find the faculty recoverable by use; whereas, though some improvement is often obtainable in this way, the amblyopia is usually to a large extent incurable. But whether an eye which begins to squint long before the development of vision is completed may not lose something is another question. We cannot test the point, but remembering how transient are the impressions received at one, two, and even three years of age—how a familiar face not seen again is absolutely forgotten—a language partly learned but not used later, entirely lost—we may suspect the occurrence of such loss. The loss of fixation power by an eye which has previously possessed it is almost a proof of loss of visual power.

For the other view there is more to be said. Many of these squinting children are more or less amblyopic in

* 'Das Schielen,' Berlin, Hirschwald, 1881.

both eyes, and it is clear that the defect in the fixing eye cannot have been caused by the squint. It is, at most, only the *excess* of amblyopia in the squinting eye that can be explained in this way, and even of this there is no proof. Seeing that in many cases both eyes fail, through faulty development, to reach the normal standard of vision, it is reasonable to suppose that in some the failure is unequal in the two eyes, or even confined to one, and therefore that the amblyopia precedes the squint and plays an important part in causing it; indeed, no other view is possible in those cases where we find great inferiority in the squinting eye, shortly after the onset of the squint.

But we may look at the question from still another point of view. To speak of the amblyopia of squint simply as a congenital defect is misleading. All eyes are amblyopic at birth—highly amblyopic. Those which later reach the standard of normal vision do so by a process which occupies probably several years. If strabismus be established before this process is complete the further visual progress of the squinting eye is likely to be hindered if not arrested.* This view of the matter finds support in the fact that the cases which present the greatest amblyopia seem on the whole to be those of unusually early onset. Among cases beginning during the first three years of life a much larger proportion have false fixation than amongst those beginning later (see Table I). That many beginning even in the first year retain true fixation may be owing to the squint being alternate, or remaining periodic till a later age. Moreover, the results of disuse would vary not only with the actual age of onset, but with the state of development at that age. Many squinting and amblyopic children are distinctly backward; they walk late, talk late, are dull and unmanageable, and are behind others of their age at school. Of course it may be that these highly amblyopic eyes squint earlier than others just because they are

* See also Barratt and Lang, loc. cit.

amblyopic, but I think we ought not to leave out of consideration the possibility that the early onset of squint may arrest the visual development of the eye. The question is important in relation to educative treatment.

Given a cause of onset, *the progress of the disorder* is easy to understand. At first the squint is usually periodic, coming and going with accommodative effort; but each lapse tends to facilitate recurrence, and in time, as the suppression of the deviating image becomes confirmed, the squint becomes continuous. We see this change occur in individual cases, and we can infer its general occurrence from the fact that the cases which we see soon after the onset are very frequently periodic, while those of long duration are very rarely so. In 52 cases of periodic squint the average duration before treatment began was two years; in 100 cases of continuous squint it was five and a half years. It is unfortunate that so few of these children come under treatment in the periodic stage—16 per cent. in my experience—for it is then as a rule that the squint is cured most easily. In some cases, however, a squint appears to be continuous from the very onset, and in some it certainly remains periodic for many years, though on that point an error of observation is easily made; some cases which appear to be periodic are really continuous, but variable in degree; the corneal reflex shows a small deviation during the periods of supposed intermission, and binocular vision is, of course, continuously absent.

Both in the periodic and in the continuous stage the large majority of squints are monolateral; in a total of 318 cases I found 259, *i. e.* 81 per cent., to be so. The alternating squints, constituting 19 per cent., were characterised with few exceptions by nearly equal refraction and nearly equal vision in the two eyes. But the two groups are not absolutely separable; a squint which is usually monolateral is not necessarily so at all times; the behaviour of the eyes will vary according to the precise method of testing them.

In the continuous stage, whether the squint be alternating or monolateral, the suppression of the deviating image becomes more and more complete, and the act of convergence becomes more and more dissociated from visual perception. The heteroscope shows this clearly. The great majority of squinters old enough to be tested with this instrument or with the fusion-tubes, can see with the two eyes simultaneously: they see the four holes, two white, a red, and a blue. Some of them with a little trouble can fuse the two white holes when the tubes stand in a particular position: their sense of fusion is not entirely lost; but they cannot maintain the fusion when the tubes are abducted or adducted from this position by a single degree. They have entirely lost the notion of making a voluntary effort for the avoidance of diplopia.

Some have no sense of fusion, or fuse in spurious fashion, placing the tubes so as to blend a macular picture in the one eye with an excentric picture in the other, according to ingrained habit. This we might expect where the squinting eye has lost fixation power, but it is surprising when met with in a patient who has normal vision in both eyes, as in some cases of alternate squint. The alternate squinter is an expert in the arts of suppression and so-called false projection. He fixes his object with either eye at will. In the other eye, at the same moment, he suppresses the macular picture which he does not want, and perceives to some extent the misplaced image of the object looked at, projecting it not falsely but truly in spite of the false position of the eye.

These secondary perversions of the visual function are at once consequences of the squint and causes of its perpetuation.

The foregoing may be summarised as follows:

1. Convergent strabismus is a disorder of innervation in which the visual centres fail to control the act of convergence. This act is thereby degraded. It becomes

purely automatic and purposeless. It is excited by the associated act of accommodation. It is excessive because it is uncontrolled.

2. The failure of control depends largely on faulty development of the visual apparatus. The fault, whether it be in the eye or in the central organs, is frequently hereditary. In many cases the power of control is lost through shock or illness during infancy.

3. Hypermetropia, when of considerable degree, predisposes to strabismus, and sometimes causes it, by demanding an abnormal effort of control. Hypermetropia of low degree does not account for strabismus in a child.

4. The disorder is confirmed and perpetuated by suppression of the function of the squinting eye. In treating it we should aim at stopping this habit of suppression and establishing the habit of binocular control.

These conclusions tell *a priori* in favour of educative treatment. But treatment must be judged by its results. In this series of cases educative measures were employed to a considerable extent, but hardly ever alone—always, or almost always, as auxiliaries to operation and the use of glasses. Moreover, treatment was often incomplete, being abandoned or neglected by reason of time, trouble, or expense, so that the results in mass are no true measure of the curability of the disorder. Again, I have no standard of results obtained in other ways with which to compare the present. It is clear, therefore, that the question at issue cannot be answered by a mere appeal to figures. Still it may be useful to give some general statement before speaking of particular results.

I take for analysis 251 cases which came under treatment during the year 1897, those registered since the beginning of the present year being on the whole too recent for this purpose. During the last few months I have endeavoured to re-examine the whole of this series; and though that proved impossible, I am able to say something as to the present state of just 200 of them. Of these 200 when last seen, 57 had binocular vision of a

certain kind; they appeared, under the red, white, and blue test, to fuse both in near and in distant vision. Separating the periodic from the continuous squints, I find that 59 per cent. of the former and 18 per cent. of the latter had recovered in this way. Eleven others fused in near vision and were not tested for distant vision, the importance of this having for a time escaped my notice. Nine others almost certainly had binocular vision, but were too young for the actual test. Twenty-two more fused in near vision, but used one eye only in distant vision. In these latter cases it was most interesting to observe how the child when standing, say, at three feet from the card would see the three dots at once, and then, on taking one step backwards, being unable to diminish the angle of convergence sufficiently for that distance, would instantly suppress the use of one eye and see two dots only. In the remainder, *i. e.* in just about one half the cases of known result, binocular vision was absent both in near and distant vision. This latter group included many patients who were cured as regards appearance. It naturally included most of those who had false fixation at the outset and many in which the treatment had been abandoned or interrupted.

These figures, please remember, relate to fusion merely, *i. e.* binocular vision of an elementary kind, not to the fully-developed sense of perspective or solidity. This latter was recovered in 16 cases, as proved by the drop test, and probably in others, for the test was not applied, as it should have been, to all who had recovered fusion. I have lately observed that those who fuse in near vision only may see in perspective at that distance, although suppression with one eye occurs in distant vision.

These results, no doubt, are not all final. Some of these patients have the faculty of fusion on uncertain tenure and may lose it in the future, especially if they are careless as to using glasses. On the other hand, some who have it not will probably still acquire it, and those who retain it will certainly develop it more fully.

Those, especially, who have it now in near but not in distant vision are likely to extend it to the latter also. I have seen this happen several times.

I pass, in conclusion, to the *specific results of educative treatment*. The means employed were of three kinds: occlusion of the eye by means of a shade or pad; bar-reading; and the use of the fusion tubes, these being intended as a simple substitute for the stereoscope.

The shade was used with more or less persistence in 118 of the 251 cases. Its purpose is not so much to give the squinting eye a greater acuteness of vision, as to compel it to use such vision as it has, to promote fixation and to prevent or stop the habit of suppression. There is a period when the faculty of fixation can be saved—or lost. In January, 1897, I saw a child of eighteen months with periodic squint of short duration in the left eye. The eye fixed the mirror readily, as shown by the corneal reflex. Both eyes under atropine had H. 3 D. I ordered a shade to the good eye, and should probably have given glasses later, but the treatment was neglected. Fifteen months later I saw the child again, and found a continuous squint with false fixation. In contrast with this my records show seven cases which at first had false fixation, but recovered true fixation under treatment. In every instance the recovery was aided by the wearing of correcting glasses, but it would not have come about without occlusion of the fixing eye, for it was attained before the squint was got rid of, so that without compulsion the squinting eye would never have fixed at all. Binocular vision is now re-established in one of these cases, and appears to be so in two more, but the children are too young for the actual test. False fixation, then, though usually incurable by any reasonable amount of effort, is not always so, and in young children especially we ought, I think, to give the eye a chance.

In the more hopeful and larger class where the squinting eye has still the power of true fixation the shade is often of distinct advantage. Just where the advantage

is probably the greatest, namely, in young children, we cannot measure it, but we can see it. At first the child rebels; endeavours to remove the shade or to look sideways from behind it; failing this, is awkward in guiding itself, is apt to fall, is unable to put its finger smartly on a given spot—in short, has *false projection* through using its sight in an unwonted way. Soon, however, these difficulties begin to disappear; the shade is tolerated; the mother assures us that the child can use the eye much better, or, perhaps, complains that we have driven the squint into the other eye. The eye has become more useful through being used. In my series I find ten cases which, at first monolateral, showed a tendency to alternate after persistent occlusion of the fixing eye. Such advantage, no doubt, is transient if we stop the shade and proceed no further, but when we follow it up by operation it helps unquestionably in the recovery of fusion.

During treatment the vision of the squinting eye, as measured by Snellen's letters, rose a little in many of my cases, greatly in a few. Some of this improvement may have been due to the continued wearing of a proper glass, for eyes which have no squint frequently show a gradual betterment of vision during the few months following the correction of refractive errors. In one case, however, vision rose from $\frac{6}{60}$ to $\frac{6}{12}$, though the same glasses were worn throughout and had been worn for some years when the case came under treatment. In this case, together with the use of the shade, a large divergence due to operation eight years earlier was corrected.

For stopping the habit of suppression the shade is invaluable. When glasses, or glasses and operation, have brought the squinting eye into fairly good position, there often remains a trifling squint which the patient makes no effort to correct. He cannot, for he is not conscious of the displaced image. By covering the fixing eye for a time, we may arouse the dormant vision of the other,

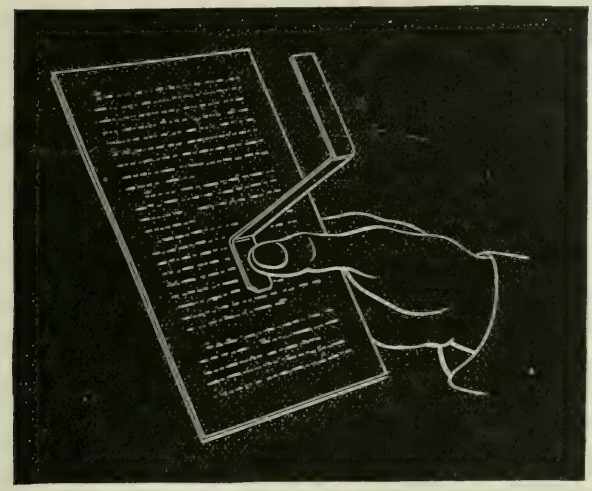
and he may then be able to perceive the two images at once, and to unite them by adjusting the position of the eyes. To cure the habit of suppression the shade must, for a time, be worn constantly on one eye or the other: on the good eye as much as possible, and at other times on the bad one, for the squinting eye had better be in darkness than continue to form images which the brain does not perceive. Occlusion of the good eye for a certain time each day may suffice to prevent a young child from losing the faculty of fixation, but it will not banish the habit of suppression.

I have usually attempted to occlude the eye by means of the ordinary celluloid shade with an elastic cord, placing the shade beneath the spectacles, but this is sometimes difficult to manage. A pad of cotton wool held in position by the spectacles often answers better.

Bar-reading—the *lecture controlée* of Javal—was used in thirty-one cases. A bar of some kind, such as a paper-knife, a ruler, or a strip of card, is held between the eyes and the book in such a way as to hide a part of each line from each eye respectively. The patient's own fore-finger will answer the purpose if held properly, and has the advantage of being always at hand. The most convenient implement, I think, after various trials, is a thin strip of metal (Fig. 6) bent in two places at a right angle so that it can be held upon the book with a thumb or finger. It is steady in relation to the book, and can be moved easily up and down the page. The patient must be taught how to use it. When his fixing eye reaches that portion of the line which is hidden from it by the bar, he must use his other eye. There must be no guessing and no dodging movement of the head or book. At first the bar will block the line completely. To show him that the other eye can help him out if he will make it work, we cover the fixing eye for a moment with a screen. Next we teach him to occlude it for himself, at first perhaps with his hand, but as soon as possible by a momentary closure of the lids. He will learn this in a

day or two, if not at once. Soon he will be able to travel along the line with only a slight hitch where he closes the better eye, and at last he will read smoothly keeping

Fig. 6.



Bar-reading.

both eyes open. No one who has seen a patient work his way through these several stages can doubt that bar-reading aids in the recovery of binocular vision. It is chiefly effective when practised in conjunction with the use of the shade. The following example was an early one in my experience, and strongly encouraged me to further trials. A young adult who had squinted from early life was treated by glasses and operation. A slight deviation inwards and upwards remained. He had no diplopia and no spontaneous tendency to fuse. With the tubes he could fuse without much difficulty. He was advised to cover the fixing eye, to uncover it only for the purpose of bar-reading, and to practise this latter as much as possible. At first the reading was difficult, but he worked at it with a will, and in six weeks was found to have actual fusion. Bar-reading was continued for a

while for fear of relapse. Re-examined ten months later he had fusion both in near and distant vision.

One other example. A girl of seventeen had a large alternate squint of fourteen years' duration. She was treated by glasses and a single tenotomy. Eight weeks after the operation she still had a squint of 5 degrees or 15 degrees according to which eye she used. She was then taught bar-reading and wore a shade over the right eye in the morning, the left in the afternoon (Javal). Two months later she fused in near vision, and a fortnight later in distant vision also. The drop test, to my surprise, now showed sense of perspective. Five weeks later the result was maintained.

The value of the method in certain cases is beyond question. Its weak side is that it is inapplicable in very early life. To older patients it affords an interesting occupation.

The *fusion-tubes* were used, together with other treatment, in twenty-one cases. The plan was to let the patient hold them in such a way as to blend the two white holes; then to separate and join these many times in succession so as to get the idea of fusing double images; then to overlap them partly and try to make them go together by looking at them. Lastly, to practise this at home. Seeing that this exercise grows easier with a little practice, I presume that it serves to stimulate the sense of fusion. It is irksome if long continued, but interesting for a while, and can sometimes be managed by children who are too young for the reading-bar.

With the stereoscope proper I have done very little; time failed for any sufficient trial.

The old idea that the squinting child needs a little skilful cutting and nothing more is dying out. Most people know that glasses are often necessary. But that the child may require *teaching*, at some trouble, to use the squinting eye, is a new idea to many. It is easily grasped, however, and *must* be grasped if our efforts are to be effective. I have used the word *educative* as a help

in that direction. Of course there are parents and there are children on whom all time and trouble spent in this way are entirely thrown away, but on the whole I have been surprised at the care and patience with which directions have been carried out, even in homes where one might least expect it.

In this lecture I have stated only my own experience; it has been impossible to compare it with that of others. I have referred but little even to Javal; but those who know his work, especially his recent 'Manuel du Strabisme,' will know how much I am indebted to it. On some points of etiology his views are, I think, open to question, but as regards the education of the visual function which he has so ably advocated, I am convinced that the principle is true and the method practically useful. Used, rarely by itself, usually in conjunction with other treatment, it promotes real as distinguished from apparent cures of squint, and gives the maximum security against relapse.

REPORTS.

I. DISEASES OF THE EYELIDS.

1. *Lupus of the intermarginal space of each lower lid.*

By Sydney Stephenson.

Maria O—, æt. 29 years.

Family history.—Father and mother died of phthisis. Eight or nine of patient's brothers and sisters have also succumbed to that disease.

Personal history.—Some seven years ago several patches of lupus appeared on face. These were scraped and burnt, and scars are now to be seen. Within the last year a recurrence has taken place, for which she consulted Dr. D. Walsh at the Western Skin Hospital. That gentleman found multiple, red, sharply defined patches about the skin of the face, which he regarded as a superficial type of lupus vulgaris. The diseased areas had raised papular edges. Dr. Walsh also noticed that the patient's R. E. was inflamed, and asked me on that account to examine the case. At that time (November 5th, 1897) the R. E. was rather red and very irritable, while there were a number of small grey spots superficially placed in the cornea. In short, the condition at that time closely resembled an affection described by Fuchs under the name of keratitis punctata superficialis.

December, 1897.—Keratitis of R. E. better, but inner third of intermarginal space of lower lid red and ? ulcerated.

January 24th, 1898.—Intermarginal space of left lower lid similarly affected.

March 7th, 1898.—A portion of the intermarginal space of each lower lid now red and angry looking. Palpebral conjunctiva not involved.

Mr. Stephenson said the interesting points about the case were three in number: (1) the fact that the girl's father and mother, and eight or nine of her brothers and sisters had died of phthisis; (2) the slow course of the disease, which had lasted over nine years; (3) the fact that the deposits on the intermarginal space of each lower lid were not connected with the deposits existing upon the face; they seemed to have appeared independently.

(*Card specimen. March 10th*, 1898.)

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2. *Phagedæna of eyelids.*

By Gustavus Hartridge.

H. K—, æt. 23½, presented himself at the Royal Westminster Ophthalmic Hospital, and gave the following account. Never had a day's illness till fifteen months ago, when he contracted gonorrhœa, which got quite well after six weeks' treatment. Last Christmas a rash appeared over his chest and arms; this was followed by a sore throat. On consulting a doctor he pronounced the rash to be a secondary specific eruption. There is no history of a primary sore, though the patient admits to have had some swelling of the inguinal glands before Christmas. At the end of last April he noticed some inflammation of the left upper lid, which soon extended to the lower; and two weeks later the right lids became affected in a less degree.

The condition of the lids when first seen on May 26th, 1898.

Right lids.—On the upper one was a red patch, swollen and slightly indurated, about the size of a small bean, and on the lower lid was a similar patch; on everting the lids the mucous membrane corresponding to these was ulcerated.

Left lids.—The upper lid showed a large gap in its centre, which had been destroyed by the ulcerative process; the edge of this was clear cut and still extending. On the lower lid, between the centre of the lid and the outer canthus, was a large red thickened patch, ulcerated on the conjunctival surface, and showing some destruction and irregularity of the tarsal edge.

The ulceration was in all the lids phagedænic in character, having sharply cut edges, while the ulcers themselves were covered with a greyish slough, which was difficult to remove, and left a bleeding surface.

On examination of the throat the posterior part of the pharynx was seen to be extensively ulcerated, presenting exactly the same characters as the ulcers of the lids.

There is considerable enlargement of the lymphatic glands above the elbow, and the patient has several large sores on the forehead, and one in front of the left ear, which look like tertiary syphilis.

The treatment adopted was actual cautery to the ulcers and large doses of Potassii Iodidi, and under this treatment great improvement has taken place.

(*Card specimen. June 9th,* 1898.)

3. *Large fibroma of upper eyelid.*

By Simeon Snell.

W. D—, æt. 43, presented himself at the Sheffield Royal Infirmary in August, 1897, on account of a tumour of the left upper eyelid. He had noticed it ever since he was a boy, in fact he never remembered himself without it. It very slowly increased in size, but had perhaps done so more rapidly of late. It is now pedunculated, about the size of a filbert, with little depressions on its surface. It is firm feeling, and is attached to the upper eyelid, just external to the upper punctum. It hangs down over the eye, and by its situation and weight interferes with sight and the movements of the eyelid.

The tumour was easily dissected away on August 30th, and there is no further note to record.

Mr. A. M. Connell, house surgeon, has given me the following report of its structure:

"On examination the tumour was found to be about the size of a small almond, ovoidal in shape, pedunculated, hard, and the skin covering it tense. The pedicle was tough and somewhat constricted. On microscopic examination the skin was everywhere continuous with the deeper structure of the tumour, which consisted of fibrous tissue scattered in every direction, and not uniformly arranged in bundles, with few blood-vessels, but a large number of lymphatic vessels; a few nerves were to be found. There is no yellow elastic tissue, and no capsule. On section the tumour was dense, white, and glistening; skin closely adherent to rest of tumour."

(*June 9th*, 1898.)

II. DISEASES OF THE CONJUNCTIVA.

1. *Urticaria perstans with affection of the conjunctiva.*

By L. Vernon Cargill.

E. F—, æt. 4, first came under my care at the Royal Eye Hospital, Southwark, August 23rd, 1897, with an urticarial rash, and an affection of the left eye.

She is the youngest of three children; the other two are healthy. Father and mother healthy, except that the former suffers a little from rheumatism. Mother remembers having had nettle-rash when a child after eating some crab.

No ailment until about fifteen months ago. She was at Herne Bay when the mother noticed some pale raised patches on her arms which she took to be nettle-rash, although the child had eaten no pork, shell-fish, or other article of diet likely to produce it. The patches quickly and entirely disappeared, but a little later came back worse, and of a darker hue. The patches continued coming and going through the winter, but this summer they became more marked and extensive, and in August the left eye became affected.

On first being seen it was noted that the child looked of a rather delicate and nervous disposition. The larger vessels of the left ocular conjunctiva were somewhat distended, and there were patchy flat swellings, as if caused by effusion into the deeper layers, in appearance not unlike the swelling of slight chemosis, firm and not at all flabby, the elevation being slight and uniform. The patches had a pale yellowish-brown tinge about them, reminding one of a stage in the absorption of a

subconjunctival ecchymosis. There was no discharge, and there did not appear to be any irritation. The cornea, iris, ciliary body, media, and fundus were all perfectly healthy. The right eye was unaffected. Scattered over the arms, legs, the face chiefly and the trunk slightly, were typical, flat, raised, firm patches of urticaria, palish brown in colour, with reddish border, and slight surrounding erythema in places. They were irregular in shape, varied much in size, and were not arranged in any definite or symmetrical manner. The appearance of wheals soon followed a rub with a finger nail, and it was found that they soon ensued on any irritation of the skin. The child did not appear to suffer greatly from itching or burning, only scratching itself occasionally, and then chiefly at night when warm in bed.

About a month after the first visit the right eye became similarly affected to the left, and both eyes have remained affected since, but in varying degree, and with gradual improvement on the whole. The extent of the conjunctival swelling varies, like that of the skin, from day to day and week to week. Sometimes the ocular conjunctiva of one or other eye seems to be affected as a whole, and sometimes only particular areas; but the condition has generally been most marked in the ciliary region, and has faded there last. The palpebral conjunctivæ have not been found affected, nor the mucous membrane of the mouth, tongue, or pharynx. The larger cutaneous patches sometimes take a month or six weeks to fade away, and they are frequently being added to by successive crops of eruption.

There is no indigestion. The heart, lungs, and abdominal viscera are normal, and there is no albumen or sugar. The child occasionally suffers from threadworms.

(*Card specimen. November 11th*, 1897.)

2. *On epithelial xerosis of the conjunctiva.*

By Sydney Stephenson.

Theodor Saemisch appears to have been the first systematic writer to apply the name "epithelial xerosis" to a superficial change of the ocular conjunctiva, limited parts of which become dry and lustreless, and are covered with a foam-like whitish substance. The condition described by him may or may not be associated with definite night-blindness. He drew a distinction between the epithelial form of xerosis and the parenchymatous, in which the mucous membrane is atrophic, and converted, wholly or in part, into scar tissue.

Little has been published in England upon the subject of epithelial xerosis. From this dearth of literature it might be inferred that such cases are few and far between. The affection, however, is one that I have had many opportunities of seeing, and I quote the following figures in support of the view that epithelial xerosis is far from uncommon in this country. The statistics, it should be explained, are drawn from schools (residential and otherwise), the scholars of which belonged for the most part to the lower strata of society.

For our present purpose the various institutions may be conveniently distinguished by letters, thus :

A. A poor law school, which contained upon the occasion of my visit in July, 1896, 235 inmates, of whom 5 (or 2·13 per cent.) were affected.

B. A London union school with 512 inhabitants on July 29th, 1896. Of that number 8 (or 1·56 per cent.) showed epithelial xerosis.

C. A Catholic orphanage contained on August 10th, 1896, 193 lads, of whom 9 (or 4·66 per cent.) showed the condition alluded to.

D. A metropolitan union school having upon August

3rd, 1896, a population of 330. Among these children 4 (or 1·21 per cent.) had xerosis of the conjunctiva.

E. A Catholic orphanage with 150 girls on August 10th, 1896, included 4 (or 2·67 per cent.) who were affected.

F. A Catholic school with a population on August 18th, 1896, of 88 little boys and girls, had 3 (or 3·41 per cent.) affected.

G. An orphanage, the inmates of which on August 25th, 1896, included 446 boys over seven years of age. Among that number 5 cases (or 1·12 per cent.) were discovered.

H. A Liverpool church school had on October 1st, 1891, 649 scholars, of whom 5 (or 0·77 per cent.) had xerotic patches on the conjunctiva.

I. A Wigan church school contained upon September 28th, 1891, a total of 598 children, among whom 4 instances (or 0·67 per cent.) of xerosis were found.

J. A training ship with 472 lads on board. Of that number 11 (or 2·33 per cent.) were on August 15th, 1896, discovered to be suffering from epithelial xerosis.

So far I have spoken of institutions visited upon a single occasion. My list will terminate with the figures obtained from two schools, both of which were inspected more than once.

K. A Roman Catholic orphanage, receiving lads up to the age of about nine years, contained upon August 17th, 1891, a total of 137 children, of whom 13 (or 9·47 per cent.) were affected. I visited the place again upon July 29th, 1896, when I found that of the 133 inmates 9 (or 6·77 per cent.) were the subject of xerosis.

L. A metropolitan poor law school admitting children of both sexes from three to sixteen years of age. The population numbered 800 on September 14th, 1895, when 18 cases of epithelial xerosis (or 2·25 per cent.) were discovered. The school was again inspected by me on June 27th, 1896, upon which occasion 9 instances of xerosis (or 1·16 per cent.) were found among the 779 inmates. Lastly, on August 16th, 1897, the inmates, who then numbered 687, showed 9 cases (or 1·31 per cent.)

It will be perceived, then, that examples of *xerosis conjunctivæ* at particular places ranged from as few as 0·67 to as many as 9·47 per cent. of the population. The figures as a whole may be summed up by saying that of the total number (6209) of children examined, 1·87 per cent. were affected. It will be noticed that my inspections were made during summer and autumn, when sunlight in this country is more powerful than at other seasons of the year.

The changes characteristic of epithelial xerosis are never met with* except in the so-called interpalpebral zone, a region defined by Fuchs (2) as " that part of the cornea and of the scleral conjunctiva which ordinarily is not covered by the lids." They are specially prone to affect the temporal side of the ocular conjunctiva, possibly because a larger area of the mucous membrane is exposed to the influence of light and air there than elsewhere. They take the form of greasy, glistening, dry-looking patches, which once seen can hardly be mistaken for anything else. If of large size they correspond in outline with the external angle of the open lids, conveying the impression to one's mind that they have been swept into place by the movements of the eye. However, a triangular or oval shape, although characteristic, is by no means invariably met with, particularly if the affected area be small. The size and shape of the patches often differ in the two eyes, supposing the changes to be bilateral, which is not always the case. They are sometimes ridged, doubtless due to successive but unequal excursions of the eyeball outwards or inwards. The spots themselves appear slightly raised, and fluid adheres with difficulty, or not at all, to their surface. They do not stain with fluorescine, although they may be tinted by dropping into the eye a weak solution of methylene blue and some other basic aniline dyes. The xerotic areas, when examined by

* It should be stated that this description refers to what I have myself seen. I am well aware that Cohn (3) and others have described cases of xerosis which involved the whole extent of the ocular conjunctiva.

the aid of a magnifying glass, give one the impression of being made up of so many minute globules of mercury, often arranged in parallels, joined by cross branches. They may be readily wiped away, as by movements of the lids, when white, rather resistent particles may be found lying free upon the palpebral conjunctiva. The silvery scales are reproduced within twenty-four or thirty-six hours after complete removal, as, for example, by scraping with a small blunt spoon.

The xerotic patches show no loss of local sensibility. When of small dimensions, repeated blinking may render them inconspicuous, but as the tears do not moisten them for more than a few seconds, they soon come into view again. The conjunctiva in their neighbourhood may have a faint yellowish hue, be permeated by dilated vessels, and be thrown into little folds concentric with the edge of the cornea, when the eye is moved outward or inward, as the case may be. Finally, many of the affected eyes, when exposed to light, redden and water easily.

The presence of bacilli in the conjunctival patches has been noted by many observers, amongst whom must be especially mentioned Colomiatti (4), Leber (5), Kuschbert and Niesser (6), and Fraenkel and Franke (7). There is no practical difficulty in demonstrating the existence of these organisms. One need simply remove with a small spatula from an affected conjunctiva some of the frothy material, which is then mixed with a little sterile water or broth, and mounted as an ordinary film preparation. This may be treated with any of the basic aniline dyes, as methylene blue, thionine blue, methyl violet, or fuchsine. The best specimens, however, are to be got by Gram's process, using eosine as a counter-stain. The organisms, which vary greatly both in length and in breadth, often cling in vast numbers to the epithelial cells, and take the form of rod-shaped bodies with rounded ends. They are in many cases somewhat curved upon the flat, so that when two come into close relationship, as not infrequently happens, an S-shaped figure is produced.

I have not been able to demonstrate the existence of a capsule around each microbe, although the fact that they look larger when stained by Gram's method perhaps indicates that such exists. No flagella can be seen when the specimen is treated by Löffler's well-known plan.

If a tube of serum or of agar streaked with human blood be smeared with a sterilised wire previously drawn across one of the conjunctival patches, and be then kept at incubation temperature, innumerable, tiny, greyish-white colonies, of circular form, will be observed, as a rule, *within sixteen hours*. These increase both in size and in number, so that a fairly luxuriant growth will usually be obtained within forty-eight hours. It is rare, however, for individual colonies to exceed 0·5 mm. in diameter. When fully developed, the latter have a characteristic dry, glistening, fatty appearance, which has been commented upon by almost everybody who has written upon the subject. Cover-glass preparations from such a tube show that most of the bacilli are segmented in their entire length, while many have clubbed ends. Their arrangement, one upon another, often recalls that of red blood cells under the microscope. The organisms at this stage, as pointed out by Dr. J. Eyre (8), could scarcely be distinguished by the microscope alone from diphtheria bacilli. These various points are brought out better when the specimen is stained by weak phenyl-fuchsine, and especially with carbol-methylene blue, than by other methods. The bacteria retain the stain in Gram's plan so tenaciously that, even after immersion in absolute alcohol for many minutes, they are still coloured.

The xerosis bacillus will also grow upon ordinary and upon glycerine agar-agar (2 per cent.), and the resulting cultures offer two points of contrast with those on serum or on blood-agar: (1) they develop with less rapidity, and (2) they tend to remain discrete for a much longer time. Upon gelatine, at room temperature, the microbes form small, separate colonies, but this medium has seemed to me much less suitable than those mentioned above. In

broth, however, the bacillus grows well, forming many small, whitish clumps (easily visible to the naked eye), which accumulate at the bottom of the tube. Milk, again, is a favorable medium. Potato, on the contrary, is distinctly inimical to the growth of the xerosis bacillus.

Undoubtedly the readiest way of obtaining growths from the conjunctiva is to inoculate serum or blood-agar in the first instance, and afterwards to transplant the organism to ordinary agar-agar or other favorable medium. In this respect the parasite reminds one of the tubercle bacillus, which will readily develop as a subculture upon glycerine agar, a material almost useless for the making of cultures directly from tuberculous foci.

Among my numerous cases of epithelial xerosis I have never yet failed to find the foregoing bacilli, not only in cover-glass preparations, but also in cultures made from the frothy patches.

At the same time it must be borne in mind that these bacteria are common apart from actual xerosis. For example, they may be now and then demonstrated in the normal conjunctival sac, as pointed out by Fraenkel, Uhthoff, and others. Speaking for myself, I am familiar with them under such circumstances, but as I have kept no notes of my examinations, I am not in a position to say in what proportion of cases they occur. Again, they are to be met with in various superficial inflammations of the eye, as catarrhal, phlyctenular, and follicular conjunctivitis, and trachoma, subacute or chronic. Their existence in keratomalacia has been commented upon by several observers, as for instance, Leber (5), Schulz (10), and Denk (11), while I have myself seen them in association with that very serious malady. They are constantly present, too, in the dry, white patches found upon wrinkled conjunctiva of patients with parenchymatous xerosis, such as may follow trachoma.

Case 1.—Annie S—, æt. 28, contracted trachoma about twenty-two years before she came under my notice.

Upon examination the corneæ were hazy from old pannus and nebulæ. R. V. $\frac{2}{36}$ and J. 12. L. V. $\frac{1}{36}$ and J. 16. The near types held at 4 cm. from the eye. Although the tarsi of the upper lids were deformed ("scaphoid"), yet there was no trichiasis. Most of the lashes were lost. The palpebral conjunctiva was markedly contracted, and in places soldered to the ocular conjunctiva by cicatricial bands. A dry, foamy patch was noticed in each palpebral fissure, to the outer side of the cornea, and xerosis bacilli were obtained from these by the usual methods.

Furthermore, the organisms may be found in scanty numbers in the whitish, cream-like substance that collects about the lids in some chronic inflammations of the conjunctiva. This observation, for which we are indebted to Schleich (12), I have confirmed in the last twenty cases that have fallen under my immediate notice. Lastly, they may be demonstrated in those curious xerotic changes that now and again follow ulceration of the cornea, mostly in blind or semi-blind eyes. Three of these rather rare cases were described by Hocquard (13) under the name "Plaques épithéliales de la Cornée." Leber (5), moreover, has alluded to them as instances of secondary xerosis—that is to say, a form of xerosis appearing in eyes that have suffered from chronic conjunctivitis or keratitis. In the whitish froth he found numerous short bacilli and cocci, which he was unable to distinguish from the organism of epithelial xerosis. The following is a case in point:

Case 2.—Robert G—, æt. 6. About four and a half years before coming under notice the child suffered from measles and whooping-cough, followed by inflammation of the left eye. When examined by me (October, 1896) the left cornea showed a large opacity, to the hinder surface of which the somewhat atrophic iris was attached (*leucoma adherens*). Towards the centre of the leucoma lay a slightly raised patch of white colour and satiny

sheen; it was oval, and measured 2·5 mm. by 2 mm. It could be scraped away almost completely. The eye was neither painful, tender, nor reddened. Perception of light was lacking; tension was normal. The patient was again seen some ten months later (August, 1897), when no change was found to have taken place in the condition of things. Upon this occasion xerosis bacilli were demonstrated in smear-preparations and in cultivations made from the central white plaque. When examined three months later (November, 1897) the left eye had become convergent to the extent of about 20°, while the curious little patch had almost disappeared from the cornea.

Before passing away from the subject, the fact should perhaps be mentioned that Schreiber claims to have found this organism in gangrene, soft sores, and in pus both from gonorrhœa and from an ulcer of the leg (Krienes [14]).

The experimental evidence, as far as it goes, is dead against the pathogenicity of these bacilli, both as regards men and the lower animals. Kuschbert and Neisser, for example, inoculated, but without success, the conjunctiva of dogs and of rabbits. Fraenkel and Franke, again, injected the bacilli into the veins, peritoneal cavity, anterior chamber, and under the conjunctiva of rabbits, guinea-pigs, and mice, but without result; they introduced the organism into the human conjunctival sac, also with negative effects. Cirincione's (15) investigations, too, lead him to believe that the organisms have no pathogenic power in respect of the conjunctiva. Gallenga (16) found that they gave rise to no disease, unless associated with staphylococci, when grafted into the eyes of rabbits. Piltz (17) and Braunschweig (18) inoculated the human conjunctiva without setting up any local disease.

My own experiments upon the human conjunctiva confirm the statements made by these various writers. They were divided into three classes: first, attempts to set up xerosis in the second eye of a patient with one

eye already affected, morsels of the greasy material from the conjunctiva being used for the purpose; second, attempts to produce xerosis in the eye of a second person, by conveying to it some of the frothy material obtained from another subject; and third, attempts to set up the condition by inoculating healthy conjunctivæ with pure cultures of the xerosis bacilli. Without entering into the details of these experiments, which numbered twelve in all, I may at once say that in no single instance did xerosis result.

It will be perceived, however, that all this is so much negative evidence, upon which it would be scarcely wise to lay undue stress. My results and those of others do not exclude the possibility of xero-bacilli being, after all, the agents directly responsible for the conjunctival changes. Positive results might be obtained were inoculations made upon the conjunctiva of those predisposed to disease by semi-starvation, wasting illnesses, pregnancy, or other factors of the kind, or locally upon damaged corneæ or conjunctivæ.

This suggestion is rendered reasonable by a consideration of certain facts: in the first place (as already stated), the organisms are to be invariably found in the characteristic silvery-grey conjunctival spots. Secondly, it is at all events suggestive that outside the human body they grow best at incubation temperature, and upon serum or agar smeared with human blood, as do some other microbes about the pathogenicity of which there is now no serious conflict of opinion, *e. g.*, pneumococci, gonococci, and the bacilli of acute contagious ophthalmia. Thirdly, the xerotic changes are located precisely at those places upon the mucous membrane where the germs may most readily lodge, supposing that the latter are at all widely distributed in nature, which would seem to be the case. Lastly, the reproduction of the foam-like areas within twenty-four or thirty-six hours after complete removal reminds one of what occurs when the parasites are grown artificially.

Thus far nothing has been said with regard to the connection between epithelial xerosis, on the one hand, and night-blindness, on the other. Hubbenet (19), who was the first to describe the conjunctival changes (1860), appears to have regarded the silvery scales as invariable signs of hemeralopia,* and most observers are now agreed that the two are frequently associated.

At the same time it is somewhat difficult to say, with any approach to trustworthiness, in what proportion of cases xerosis coincides with night-blindness. The question, indeed, is surrounded by many fallacies. In children under six or seven years of age evidence of hemeralopia must, to a large extent, be based on purely conjectural grounds, and even in older subjects dependence has sometimes to be placed upon mere statements. There is, so far as I am aware, no simple objective test whereby we may at once decide whether hemeralopia is or is not present. Finally, it must be remembered that in some of these cases of xerosis a difficulty in seeing at night exists upon one occasion, and not upon another.

Apart from these considerations, of the 29 instances of night-blindness described by Bitot (20), all are stated to have presented the so-called "hemeralopic spot" upon the conjunctiva. Bitot's statement was soon confirmed by independent investigations carried out by Villemin (21) among the soldiers at Strasburg. Of the 10 cases of xerosis published by Mr. Simeon Snell in the first volume of the 'Ophthalmological Society's Transactions,' all, without exception, suffered from night-blindness. But Mr. Snell's figures are, perhaps, open to the objection that, in hospital practice, medical aid is hardly likely to be sought by parents on behalf of their children unless

* By hemeralopia I mean a difficulty in seeing well at night. From the researches of Greenhill (22) and of Tweedy (23) it would seem that the use of that word in the sense indicated is not etymologically correct. In the present communication, however, I have thought it better to follow the general practice and to employ hemeralopia and night-blindness as interchangeable expressions.

conjunctival changes are associated with a definite difficulty in seeing at night. Kuschbert and Neisser (6), however, describing an outbreak of hemeralopia that affected more than half the children at a Breslau asylum, state that xerosis existed in every case. Of 33 deaf children with xerotic changes, Adler (24) found 23 suffering from idiopathic hemeralopia. Among the poorly nourished negro infants of South Carolina, Kollock (25) has come across a peculiar form of xerosis. In this disease the ocular conjunctiva is dry, discoloured, and thrown into folds, capped by silvery scales. "The xerotic condition of the conjunctiva," he continues, "is never absent in (*sic*) the negro, and is therefore pathognomonic." Dujardin (26) and Lecœuvre (27) in an outbreak at a Lille orphanage, noted night-blindness in 17 out of the 18 children with conjunctival stigmata.

On the other side, Netter (28) in 6 cases of hemeralopia, came across xerosis thrice only, a fact that led him to brand the latter as a mere epiphenomenon. Walther (29) states that he has never seen epithelial xerosis along with epidemic night-blindness. Chauvel (30), among 35 soldiers suffering from essential hemeralopia, found 4 only with epithelial changes. Hans Krienes (14), among 31 patients affected with essential hemeralopia, had 10 with xerotic patches on the conjunctiva. Truc, Gaudibert, and Rouveyroles (31) have lately examined the eyes of 362 juvenile criminals in a reformatory at Aniane. Of these, 36 had xerosis, complicated in 15 instances with night-blindness. The authors note that most of those affected were in feeble health, small for their age, and addicted to vicious practices.*

For my own part I have observed that the proportion of those with night-blindness varies according to time and place. For example, as regards the inmates of an institution (L) mentioned earlier in this paper, among the 18 cases of xerosis in 1895, no fewer than 11 (or 61

* Robert Cane (32), writing in 1840, relates four instances of hemeralopia in young men, due, in his opinion, to onanism.

per cent.) were more or less blind at night, whereas during 1896 and 1897 that complication appeared to be wholly absent.

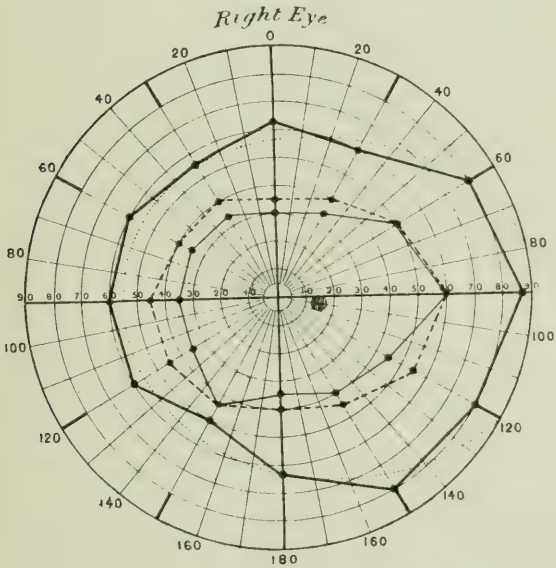
When all is said and done, we must, I think, conclude (with Saemisch and Leber) that xerosis and hemeralopia occur so frequently side by side, that the association between them is likely to be something more than merely accidental. For that matter I shall next adduce facts that tend to show their connection is much closer than generally supposed.

It is commonly taught that epithelial xerosis, in the absence of an associated night-blindness, gives rise to no symptoms beyond the appearances presented by the conjunctiva. This assertion, however, needs modification, inasmuch as I have found changes to exist in the visual fields when taken in ordinary daylight. These alterations are of two kinds, namely, constant and inconstant. The former was found in 12 cases examined during last summer and autumn—that is to say, in every one investigated fully. It consists in a reduction of the red and green fields, as taken with a circular test-object having a diameter of 10 mm. But this is not all, for the field for red is shrunken more than that for green, so that the former lies inside the latter, whereas under normal conditions the reverse should, of course, be the case. In three fourths of the patients this transposition was complete, but in the others the two fields overlapped at one or more spots. The second or inconstant change was demonstrated in 9 cases, and lies in a contraction of the limits of the field for white. As a rule, this was slight in degree, and better marked upon the temporal side of the chart, where it ranged from 5 to 10 degrees. In this connection it should be remarked that in children the field for white is usually larger than it is in grown-up persons. Hence a chart that, judged by the adult standard, may seem normal, may in reality indicate more or less contraction for white, a fact that was clearly brought out by some of my cases.

When the silvery patches have disappeared from the conjunctiva, the visual field will generally be found to have resumed its natural characters, thus indicating that the foregoing changes are not due to mere accident or to inaccuracy of observation. The following may be quoted as typical instances:

Case 3.—Lucy M—, æt. 10. On August 16th, 1897, a small frothy patch was discovered upon the conjunctiva to the outer side of each cornea. Characteristic bacilli

Fig. 7.



Thick continuous line = field for white ——
Thick interrupted line = field for green -- --
Thin continuous line = field for red —— —

were obtained in pure culture from the affected areas. Night-blindness was denied; light minimum (as tested by Förster's photometer) was 2 sq. mm. The patient was able to read J. 1 when the light was turned low. No alteration recognised in the pupils. Colour vision

FIG. 8.

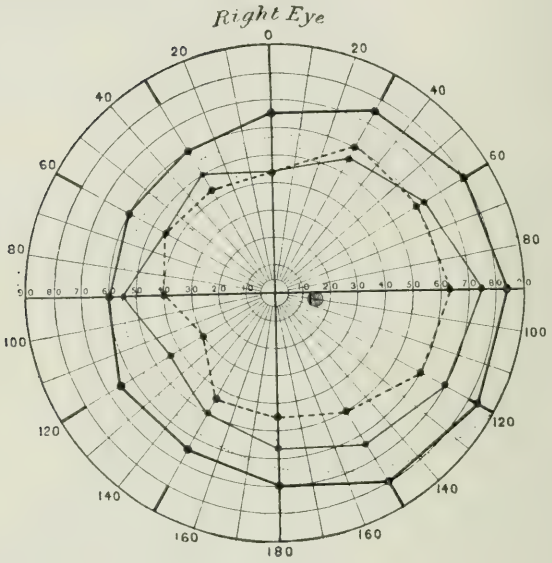
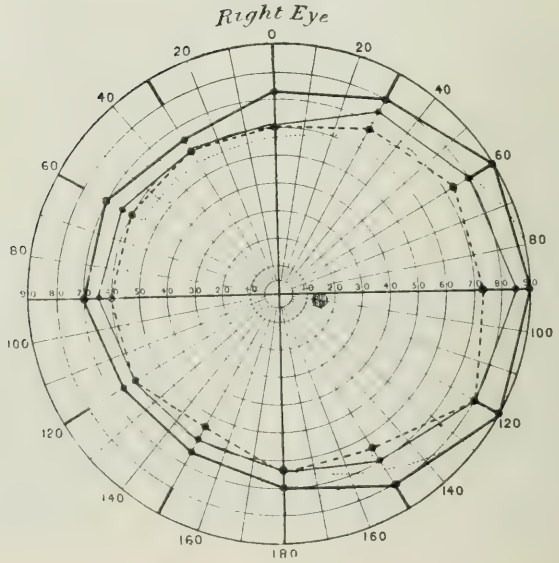

Right Eye
0
20
20
40
40
60
60
80
80
100
100
120
120
140
140
160
160
180

FIG. 9.


Right Eye
0
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40
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160
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180

normal. The fundus reflexes were thought to be exaggerated. Visual field for white, judged by the ordinary standard, slightly contracted, especially upon its temporal side. The fields for red and for green were markedly small, the former lying at every point within the latter (Fig. 7). Red blood-cells 80 per cent. and hæmoglobin 70 per cent. of the normal.

October 30th.—The xerotic changes have disappeared without treatment, and without at any time being associated with night-blindness. The field for red (Fig. 8) is larger than it was nine weeks ago, and now lies external to that for green, save in one meridian of the chart (right eye). The percentage of hæmoglobin has risen to 75, while red blood-cells now equal 90 per cent. of the normal.

November 18th.—Xerosis has recurred to a slight extent as regards the left eye. The fields for white, red, and green are larger than they were nineteen days ago, and the red field now lies wholly external to that for green (Fig. 9). Hæmoglobin 80 per cent. and red cells 116 per cent.

Case 4.—James G—, æt. 12, suffered from epithelial xerosis in the summer of 1895 and again in 1896, but upon neither occasion was it associated with night-blindness. His right ear used to discharge; he is subject to eczema of the scalp; and he has suffered from peripheral ulcerations of each cornea. His cervical glands are somewhat swollen, and the lad looks pale. Upon August 16th, 1897, he was found to have a patch of xerosis upon the outer side of each eye, the change being especially well marked upon the right side. The affected spots contained numerous xerosis bacilli, which were cultivated by the usual methods. Light minimum 4 sq. mm.; read J. 1 when the light was turned down. Colour vision normal. Pupils showed no change. Ophthalmoscopic reflexes appeared to be exaggerated. The field for white (according to the general idea) not contracted; those for red and green, however, shrunken and more or less trans-

FIG. 10.

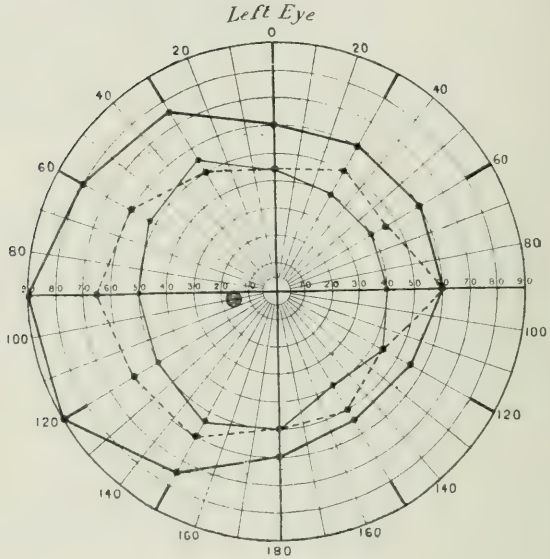
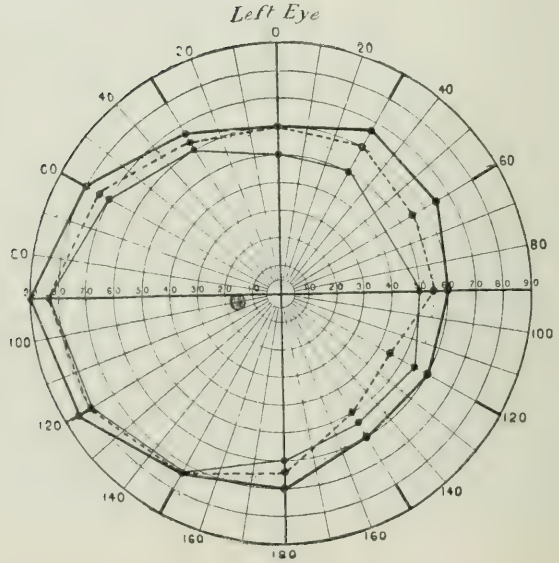

Left Eye
0
20
40
60
80
100
120
140
160
180

FIG. 11.


Left Eye
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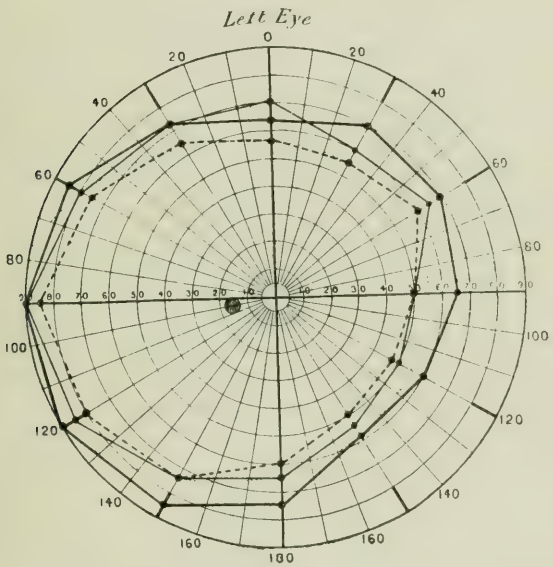
posed (Fig. 10). Hæmoglobin 55 per cent. and red blood-cells 98 per cent. of the normal. No treatment adopted.

November 2nd.—The xerotic areas have disappeared. Fields for red and for green have become larger (Fig. 11),

Fig. 12.



although the first-named still lies abnormally within the second, except in lower nasal quadrant of the chart (left eye). Hæmoglobin 70 per cent.

15th.—The conjunctival patches have not recurred; the fields for white, red, and green now occupy their natural places (Fig. 12). Hæmoglobin 75 per cent.

The next case is quoted for the purpose of showing that conjunctival changes may persist notwithstanding the fact that the fields have become normal.

Case 5.—Ernest R—, æt. 10, a somewhat delicate lad, had suffered during the summer of 1895 from triangular xerosis, in which organisms were demonstrated. Some

FIG. 13.

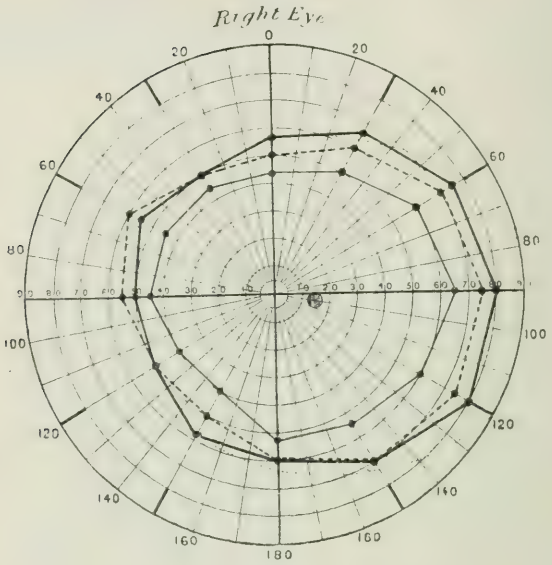

Right Eye
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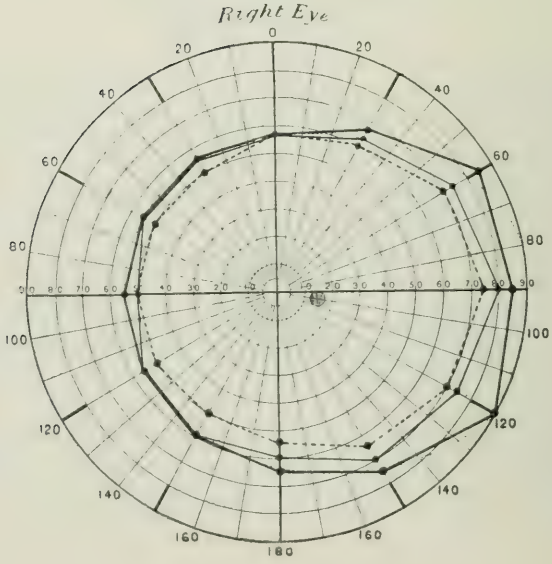
FIG. 14.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degree of night-blindness was present at that time. The conjunctival changes persisted for about four months. The condition recurred in the summer of 1896, but upon that occasion hemeralopia was absent.

August 16th, 1897.—A small patch of epithelial xerosis was found upon the conjunctiva in the external commissure of each eye. Night-blindness denied. Although the child was able to decipher in a dull light J. 1, yet the light minimum, as tested by the photometer, was 11 sq. mm. Fields for white, green, and red all rather small; the field for red lay wholly within that for green (Fig. 13). Colour sense feeble, probably as a congenital condition. Pupils equal, active, and not unduly dilated. Ophthalmoscopic reflexes certainly exaggerated. Hæmoglobin 65 per cent. and red cells 80 per cent. No treatment adopted.

October 30th.—A trace of xerosis is still present. Hæmoglobin 65 per cent.

November 15th.—The conjunctival patches, although insignificant, still in evidence. Fields for white, red, and green of natural extent, and arranged in their proper order (Fig. 14). Hæmoglobin 70 per cent.

When xerosis is complicated with definite night-blindness, the field for white and for colours is concentrically contracted to an extent that has appeared to me to bear a distinct relation to the grade of the hemeralopia. The curious transposition of the red and green fields, however, is also present. Neither ring scotomata nor zonular defects were observed in any of my patients. In other words, the changes, although more marked, are similar in kind to those found in simple xerosis, that is, uncomplicated with hemeralopia. The following is a good example:

Case 6.—Harriet H—, æt. 10. On August 9th, 1897, a tiny white patch of xerosis was noted upon the conjunctiva in each external commissure. The child stated that every night for about two weeks she had stumbled over things, such as steps or her bed. She was certainly

FIG. 15.

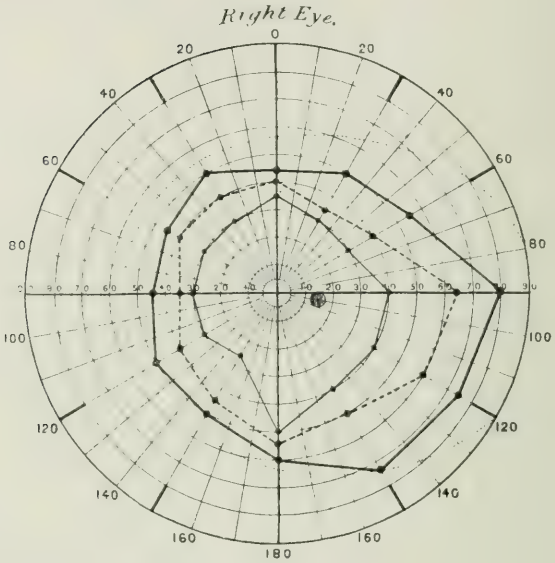
Right Eye.
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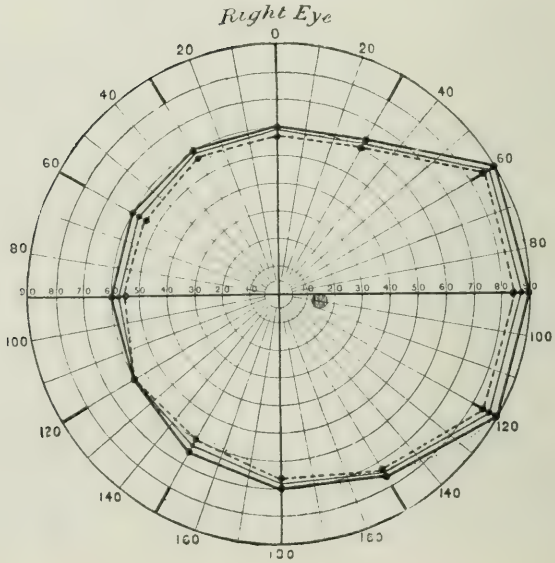
FIG. 16.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unable to get about well in a darkened room, where she could not recognise a mantel-board (of large size) until close to it. Her complexion was ruddy, and she appeared to be well nourished. Upon examination, R. V. $\frac{6}{6}$ v letters; L. V. $\frac{6}{6}$ vi letters, but good illumination needed. Light minimum 10 sq. mm. No alteration detected in the pupils. The fundi, examined without a mydriatic, showed a slightly curved reflex, roughly corresponding with the inner half of the optic disc, and lying about 2·5 mm. from that structure; the retinal reflexes, as a whole, exaggerated. No confusion as regards blues; colour sense normal. Field of vision, as taken in daylight, contracted for white, red, and green, so that the area for red fell wholly within that for green (Fig. 15). Red blood-cells 98 per cent. and hæmoglobin 70 per cent.

August 27th.—Xerosis (·25 mm.) now present upon the outer side of the left eye only. Fields as noted. Able to read "diamond" type in a dull light; light minimum 1·5 sq. mm. The patient states that she now sees well at night.

September 7th.—The xerotic patch has disappeared.

October 15th.—Neither xerosis nor hemeralopia is present. Child in excellent health. R. V. $\frac{6}{5}$ vi letters; L. V. $\frac{6}{5}$ vi letters. Fields normal, both as regards white and colours (Fig. 16). Hæmoglobin 85 per cent.

The next case is of some little interest, since it both shows the singular fluctuations that may be met with in idiopathic night-blindness, and illustrates aptly the perimetric changes associated with that condition.

Case 7.—John E—, æt. 15, had been an inmate of the Ophthalmic School at Hanwell since September 25th, 1896, whither he had been sent suffering from inflammation of the conjunctiva and "strumous" ulceration of each cornea. The lad, although small for his age, appeared to be well nourished. He was affected, however, with chronic *otitis media*, as shown by a purulent discharge from the

FIG. 17.

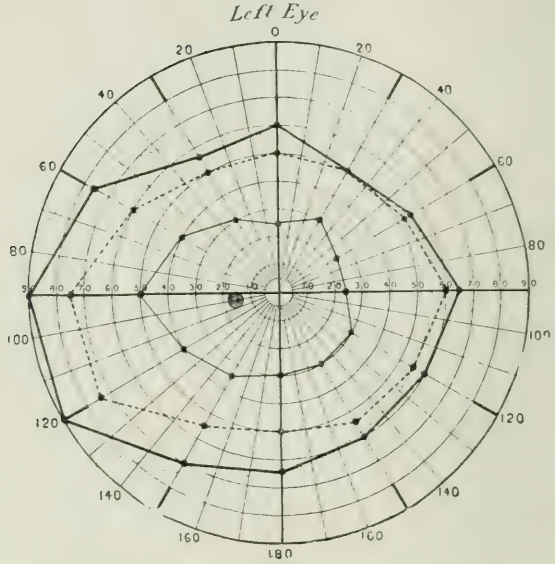
Left Eye
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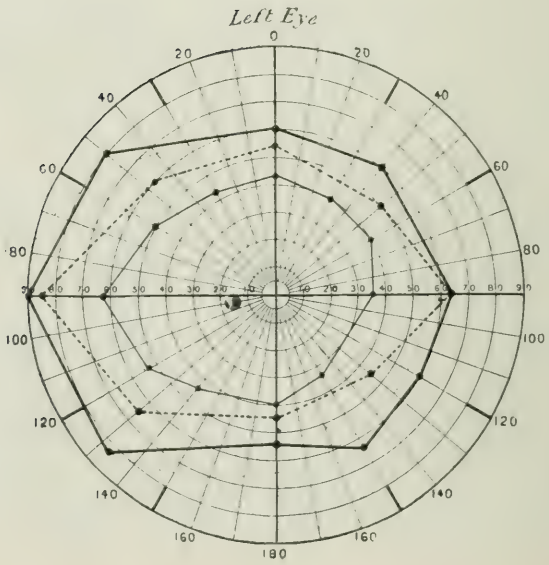
FIG. 18.


Left Eye
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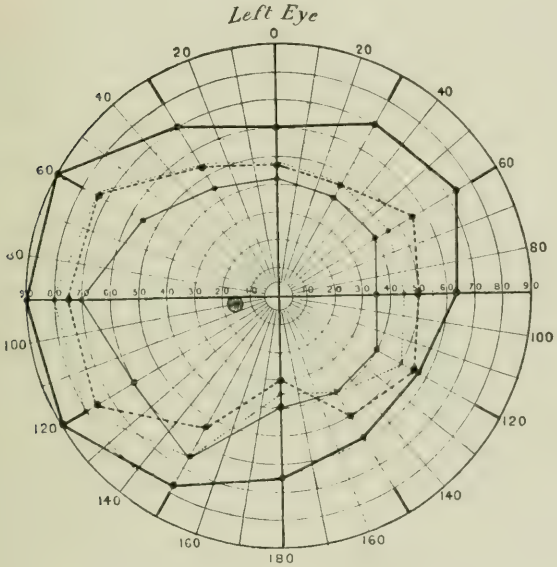
ears, perforated drums, and some deafness. Sight upon admission: R. E. $\frac{2}{60}$ and J. 16; L. E. $\frac{6}{36}$ and J. 1.

July 1st, 1897.—The patient states that whilst in his ward on the evening of June 28th 'a mist came right

Fig. 19.



Thin interrupted line = field for blue.

over his eyes' and lasted until he fell asleep. Next morning he could see clearly, but the same evening he knocked into one of the lamp-posts fixed in the boys' yard, and had to be led into his dormitory. He volunteers the statement that when living at home he experienced a similar difficulty in seeing at night, lasting from about August to December in two successive years (1895 and 1896). His diet at that time seems to have been made up chiefly of tea and bread and butter; he had meat, so he says, on Sundays only. Upon examination a patch of epithelial xerosis was found in the conjunctiva upon the outer side of each cornea, the change being more marked in

the right than in the left eye. R. V. $\frac{6}{24}$ and J. 2; L. V. $\frac{6}{18}$ and J. 1. No colour defect. Some degree of night-blindness was certainly present, as in a dull light vision sank inordinately. Fundi difficult to explore on account of the nebulæ that exist, but so far as could be made out there were no material alterations.

August 3rd.—R. V. $\frac{6}{36}$; L. V. $\frac{6}{24}$. No letters could be recognised when the lamps were turned low.

13th.—Light minimum (tested by Förster's photometer) 13 sq. mm. Hæmoglobin 60 per cent. and red blood-cells 90 per cent.

23rd.—The lad still complains of night-blindness, but states that it is less in amount.

27th.—Hemeralopia is said to vary from evening to evening. Light minimum 6 sq. mm. Xerosis now more marked on the outer side of the right cornea. The affected spot contains numerous bacilli. Field of vision, taken in good daylight, slightly contracted for white and for green, but much more so for red; the red and green fields are transposed (Fig. 17).

30th.—Although specially tested, no alteration could be made out in the lad's sense for blue; he is able to select different shades of that colour without hesitation. He states that his difficulty in seeing at night is becoming less.

September 10th.—The patient says that for the first time he was able to see quite well last night. Hæmoglobin 75 per cent.

30th.—Xerosis still present. Says that until last night he has been free from trouble, but that then he "came over dizzy and could not see." Hæmoglobin 80 per cent.

October 6th.—Xerosis persists. Pupils remain small, even when the argand lamp is turned pretty low. R. V. $\frac{6}{18}$; L. V. $\frac{6}{12}$. He is able to read J. 1 with full illumination, but not otherwise. States that his sight has been dull at night since the last note was made. Hæmoglobin 80 per cent.

20th.—A tiny patch ($\frac{1}{8}$ mm.) of xerosis is still to be

seen upon the outer side of the right eye. R. V. $\frac{6}{12}$; L. V. $\frac{6}{12}$. Field for white remains a little shrunken; red and green fields are transposed (Fig. 18). Hæmoglobin 80 per cent., and red blood-cells 94 per cent. States that he noticed some night-blindness on the evening of October 16th, when "everything looked misty."

November 8th.—Xerosis has disappeared.

12th.—Neither hemeralopia nor xerosis is present. Light minimum 4 sq. mm. Field for white normal (Fig. 19); that for red now exceeds that for green at two points (in the chart belonging to the left eye). Hæmoglobin 80 per per cent. and red cells 99 per cent.

In simple xerosis, then, and in xerosis associated with night-blindness, the field of vision shows changes that are essentially similar.

A word may next be added with regard to ophthalmoscopic appearances. In examining the fundi of my patients, all of whom were children, many peculiarities were met with; but as none of these, with the exceptions noted below, were common to all or to a majority of the cases, they may safely be put on one side. Without wishing to seem in the least dogmatic on so difficult a subject, however, I may say I have convinced myself that in xerosis (with or without definite hemeralopia) the retinal reflexes are exaggerated, while, in addition, a semicircular jagged reflex is often to be seen close to the inner side of the optic disc. These points are easier to appreciate when the examination is made under weak illumination with an undilated pupil.

From the state of the fields and of the fundi, I conclude that xerosis and hemeralopia are closely connected; in fact, I would personally go so far as to claim that every eye suffering from epithelial xerosis is in a state of incipient night-blindness, with some, though perhaps slight, signs of *torpor retinæ*.

By Adamuck (33) and others it has been claimed that idiopathic hemeralopia is due to a miasmatic cause

akin to malaria. The theory usually accepted, however, assumes them to be the outcome of two factors: (1) lowered nutrition, such as may be brought about by a scarcity of animal or vegetable food or by actual disease, and (2) dazzling of the eyes by sun, snow, electric light, or furnace-glow.

The general truth of this latter explanation is attested by a large body of evidence. Thus, the two affections are met with in people likely to be imperfectly nourished, as, for example, the inmates of poor-class schools, reformatories, orphanages, convict transports, prisons, and ships. They are extremely common, again, among orthodox members of the Greek Church during the great Lenten fast, which lasts for seven weeks, and during which the use of animal food is strictly forbidden. On the other hand, they seldom fall under notice in June, August, and December, as the fasts proper to those months are not so rigidly kept. The popular Russian remedy is beef liver, which for some reason or other is not prohibited, and the patients soon recover when that is taken, or when the religious observances come to an end. Moreover they are prone to occur in certain maladies of a weakening kind, especially scurvy, hepatic affections, malaria, and pellagra. As to scurvy, night-blindness was regarded as one of its symptoms by Sir Gilbert Blane (34) so long ago as 1785, a view endorsed since his time by many writers, *e. g.* Rees (35), Nicholls (36), &c. Numerous examples of hemeralopia dependent on scurvy in soldiers and sailors employed in the Crimean war will be found in the second volume of the 'Ophthalmic Hospital Reports.' Vaucelle (37) has related a striking instance. It appears that during a cruise in the Pacific (1876–8), eight months after leaving France, fresh meat became scarce on board, while there was a complete absence of green vegetables. Under these circumstances, eight of the crew developed hemeralopia. That symptom soon yielded to cod-liver oil, but recurred upon several occasions when meat was scanty for long

together. Three of Vaucelle's patients suffered from definite scurvy. Parinaud (38) and Leber (5) have each described a case where night-blindness and xerosis were seen in a chronic hepatic affection associated with jaundice.* With regard to malaria, Sulzer (39) states that in Java night-blindness is not infrequently a symptom of the cachexia induced by that disease, an observation confirmed by Forster and by Knies (40). Zimmermann (41) saw four children of one family, living in a low and insanitary situation, attacked by hemeralopia and intermittent fever. It was only after they had moved to healthier quarters that the night-blindness recovered. Hemeralopia is a characteristic sign of that curious Italian affection pellagra, which (according to Lombroso) is due to the consumption of unsound maize. Pregnancy, too, predisposes to its development, as in a remarkable case related by Weinstein (42). A woman, twenty-nine years of age, developed hemeralopia in three out of four successive pregnancies. The ailment, which was of paroxysmal type, commenced with gestation, and from the fourth month onward was complete, so that the sufferer is said to have been unable to distinguish anything from sunset to sunrise ; the eyes were examined by Welz, but with negative results. During an epidemic of night-blindness described by Fleury and Flechier (43), it was found that pregnant women were affected more than other people. Kubli (44), among 19 women with hemeralopia, ascertained that 6 were pregnant. Facts reported by Uhthoff (45) go to show that alcoholism may be also a factor. Among 1500 lunatics he discovered 17 instances of xerosis, 3 of night-blindness, and 7 in which the two conditions were associated. Almost all his cases were in chronic alcoholics. Achenbach (50) has published a confirmatory case. In short, whenever the general health is

* The connection between hemeralopia and jaundice has been remarked by many authors, as Scarpa (46), Bampfield (47), Cane (32), Weinstein (42), Frerichs (48), and Cornillon (49). But, so far as I know, xerosis has been mentioned only by Parinaud and Leber.

lowered, there would appear to be a predisposition towards night-blindness.

Nevertheless an exciting cause, dazzling, seems to be almost essential. Hemeralopia was formerly common in sailors exposed to the glare of a tropical sun, particularly when fresh meat and vegetables were scarce. Baillie (51), surgeon to H.M.S. Ajax, had an opportunity of investigating fifteen cases that occurred whilst his vessel lay off Algiers. He found the affection to be confined to men who did duty upon the gangways, poop, and other exposed parts of the ship. According to Sir Thomas Longmore (52), it is still frequently seen among soldiers who have passed from a northern latitude to a tropical station. Among the civil population night-blindness mainly affects those whose occupation exposes them to the causes of dazzling, as, for example, agricultural labourers, mountaineers, quarrymen, and ice hewers. Michel (53), among 47 people with hemeralopia in the Rebdorf workhouse, ascertained that 87·23 per cent. of the sufferers broke stones upon the road, as against 12·77 per cent. who were employed indoors. In this country, at all events, sunlight is the common agent. Mr. Adams Frost (54) has related two excellent instances where hemeralopia followed prolonged exposure to sunlight. His first patient had been engaged for some weeks in painting, during very bright spring weather, the *façades* of white houses. This man had, in all, no less than six attacks in as many years. Mr. Frost's second patient had been painting lamp-posts a stone colour for six weeks in bright weather, and the night-blindness was in his case associated with pain and lacrymation. Krienes (14) mentions the case of a man who, by way of a joke, looked for a long time at the sun, and in consequence developed a marked night-blindness. From my own observations among children I know that the condition in question is practically never met with save in spring and summer, although cases that have commenced at those seasons of the year may, of course, last through the

autumn well into the winter months. The glare of stone-flagged yards and whitewashed walls, together with the fact that the inmates of poor-law schools run about without any protection to the eyes in the shape of hats or caps, has appeared to me to be the immediate or exciting cause in most of my cases. The latter I have always found to be more frequent in a bright than in a dull spring.

Sunlight, however, is by no means essential, for it has been shown that exposure of the eyes to the dazzling light reflected from tracts of snow, as in the steppes of Siberia, causes night-blindness, attended, it may be, with a form of painful conjunctivitis. Thus during the war between France and Sardinia (1793), several regiments were forced to encamp on Mont Cenis and Little Bernard. Whole companies developed night-blindness, which was attributed, with every show of reason, to snow-dazzling (Weinstein). Reich (55) investigated several cases of this kind amongst labourers engaged in removing snow from roads in the Caucasus. During the recent voyage of the "Fram," Nansen, in his 'Farthest North,' alludes to a few cases of the kind. Much the same sort of thing has been known to follow exposure to the light of an electric arc lamp or welding apparatus, although there the conjunctival irritation, as a rule, was so intense as to mask the other signs, as in cases recorded by Nodier (56), Rockliffe (57), Emrys-Jones (58), Hewetson (59), &c. &c. Lastly, Evetzki (60) has found xerosis conjunctivæ to be frequent among glass-workers exposed to the heat and glare of the powerful furnaces employed in that industry. Of seventy men examined by him, thirteen showed xerotic patches, but without hemeralopia. According to Krienes (14), night-blindness was in former times extraordinarily frequent in the zinc workers of Upper Silesia, although now the affection is seldom seen, because the eyes are protected by glasses and the social condition of the men is better.

The notion was once widely prevalent that night-

blindness might be induced by sleeping with the face exposed to the rays of the moon. The existence of this "moon-blindness," as it was called, appears to me to rest upon slender evidence. The older observations may be dismissed without hesitation, inasmuch as they were made before the ophthalmoscope was invented. Hildige (61) and Robinson (62) seem to be the only English writers who in comparatively recent times have alluded to it. The former states that while in South America he came across several cases of this kind, but he fails to give any critical account of the disease. The latter merely repeats the statement proffered by a sailor to account for his night-blindness, namely, that he had been sleeping on the deck at night, and thought the moon must have shone on him as he slept.

One is almost bound to assume that of the two factors concerned in the production of hemeralopia, lowered nutrition is the more important. Otherwise it would be difficult to explain why, amid a body of people exposed to the same dazzling influences, a few alone should be affected. Thus Bampfield (47) laid stress upon the fact that while the lascars employed on the East India company's ships were exceedingly liable to the ailment, the officers nearly always escaped. This observation has been often confirmed since 1814, when Bampfield made his classical communication to the Medical and Chirurgical Society of London. The same sort of thing has been found to be true as regards soldiers. For example, Baizeau (63), out of upwards of 300 cases of epidemic night-blindness, met with the ailment twice only in officers. Poullain (64), again, treated 110 cases among soldiers without a single officer or sub-officer being affected. It would appear, therefore, as though officers, whether at sea or on shore, generally escaped the disease, an immunity doubtless connected with the better diet enjoyed by that class.

It would seem, however, that lowered nutrition, in the absence of dazzling, is not enough in itself to set up the

disease. If that were not the case we should expect to find it in this country all the year round, instead of in the spring and summer months only.

Most of the children with epithelial xerosis who have fallen under my notice appeared to enjoy good health. They were usually well-nourished, while not a few had bright and ruddy cheeks. At first, therefore, I was inclined to endorse the remarks of some other observers, especially Bitot (20), who noted as a curious circumstance in the Bordeaux epidemic that the ailment affected those in rude health, and spared for the most part the numerous scrofulous and rachitic inmates sheltered by the asylum. A somewhat similar conclusion was reached by Cohn (3), from the investigation of six cases of triangular xerosis in patients whose ages ranged from four to forty-three years. Although they were in needy circumstances, yet they showed no disturbance of the general health.

A closer examination of my cases, however, brought to light two important facts: first, that a majority showed signs of past or present "scrofula" or tubercle, as evidenced by internal otorrhœa,* hypertrophied tonsils, peripheral vascular opacities of the cornea, relapsing pustular eruptions about the face and ears, swollen upper lips, catarrh of the nasal mucous membrane, enlarged cervical glands, and synovitis of the larger joints, named in their order of frequency. Secondly, an investigation of the blood showed in every instance (fifteen) a marked deficiency in hæmoglobin, the average of which was only 65 per cent. of the normal. The estimation was made by means of Gowers' hæmoglobinometer, which is probably as useful for the purpose as the more complicated instrument of Fleischl. When xerosis had disappeared the proportion of hæmoglobin was found to have risen, but never to the normal limit. This latter observation naturally led me to inquire whether it was possible that the percentage of hæmoglobin was always below par in

* I find that Kuschbert ('Deutsche med. Woch.,' No. 21, 1884) makes the observation that purulent otorrhœa is not uncommon in xerosis.

children. Failing to find any reference to the matter in the works that deal specially with the subject, I thought it advisable to examine the blood in a number of presumably healthy children. With the assistance of Mr. G. C. Burton, resident medical officer to the North-Eastern Hospital, I investigated the point in 164 children whose ages ranged from a few months to fourteen years. The figures thus obtained have been embodied in an Appendix to this communication. It will suffice to state here that we found the percentage of hæmoglobin in every instance to fall below 100; that it varied in individual cases from 65 per cent. to 95 per cent., and averaged 76·62 per cent.; that it was slightly greater in males than in females; and that it appeared to bear no definite relationship to age.

One fact was brought out clearly by the investigation, namely, that the percentage of hæmoglobin was lower in children with than without xerosis. For example, amongst the former (as already stated) it stood at 65, whereas among the latter it was 76·62.

In my xerosis cases the red blood-cells ranged from 70 per cent. to 134 per cent., and averaged 88 per cent. of the normal, which is, perhaps, no more than might be expected in children.

From all this it follows that in xerosis the so-called "colour-index"—that is to say, the relationship between red corpuscles, on the one hand, and hæmoglobin, on the other—is generally reduced, or, in other words, a condition akin to chlorosis exists.

With these facts before us it were easy (though possibly not very profitable) to theorise. We might assume, with Parinaud and Treitel (65), that hemeralopia depended on molecular changes in the retinal pigmented epithelium, which is known to secrete the retinal purple, and that this was brought about by an impoverishment of the blood circulating in the vessels of the underlying choroid. The xerosis might be explained by supposing that degeneration had taken place in the superficial layers of the conjunctiva, whereby settlement of the characteristic

bacilli was favoured. In this view both night-blindness and xerosis would be attributable to a common cause, namely, impaired nutrition, while the former would be proximately due to dazzling and the latter to the rod-shaped bacteria.

The treatment of xerosis is a comparatively simple affair, although as the affection tends to come to an end of itself, some caution is needed in drawing inferences as to the effect of the drugs employed.

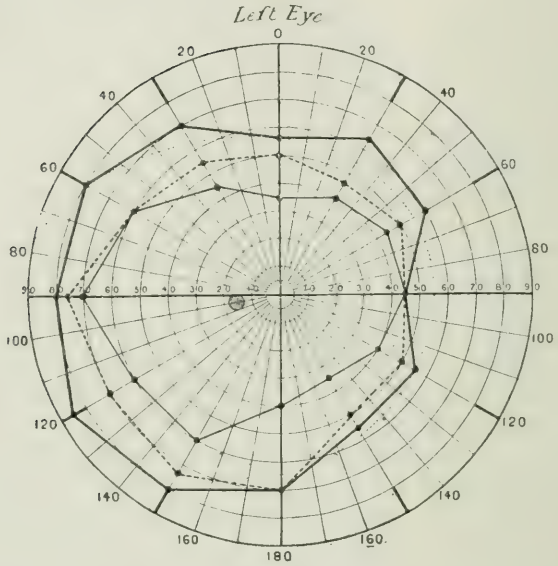
The reduction in hæmoglobin which has been shown to exist points to the necessity of administering some preparation of iron, especially the well-known Blaud's pill.* Whatever the particular preparation, it should be given in liberal and increasing doses. Iron sometimes exercises an almost specific influence upon xerosis, as shown by the case of Harriet H— (No. 6) mentioned earlier in this paper, whose symptoms yielded after eleven days' treatment by Blaud's pill. That such a speedy result is unusual, the following, taken from a number of more or less similar histories, will testify.

Case 8.—Thomas K—, æt. 11, a "strumous" subject, with a running ear, chronic vascular opacities of the cornea, ulcerated gums, and a tendency to tonsillitis, had suffered from epithelial xerosis upon former occasions.

August 16th, 1897.—A faint patch of xerosis was found upon the outer side of the left eye. Hemeralopia was absent; light minimum 4 sq. mm.; he read J. 1 when the lamp was turned low. Colour sense normal; pupils showed no alteration; fundus reflexes thought to be exaggerated. Red and green fields, as usual, shrunken and transposed, while the field for white was contracted about 10 degrees upon its outer side (Fig. 20). Hæmoglobin 75 per cent. and red blood-cells 126 per cent. After the condition had persisted for about four weeks (Septem-

* An improved formula, ascribed to Dr. Stephen Mackenzie, combines 2½ grains of sulphate of iron with 1½ grains of carbonate of potash and 1 grain of sugar.

FIG. 20.


Left Eye
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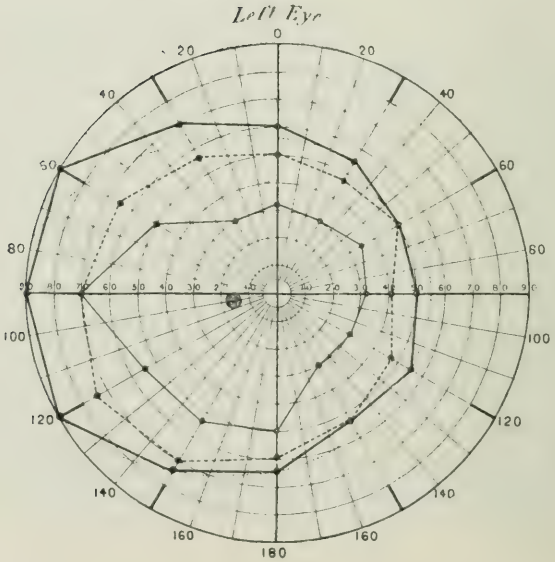
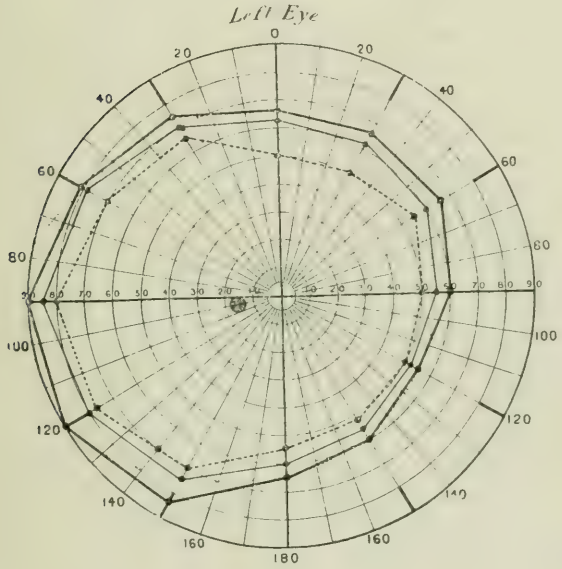
180

FIG. 21.


Left Eye
0
20
20
40
40
60
60
80
80
100
100
120
120
140
140
160
160
180

ber 19th), the patient was placed on six Blaud's pills a day. At that time a conjunctival patch was present on each eye; hæmoglobin was 76 per cent.

Fig. 22.



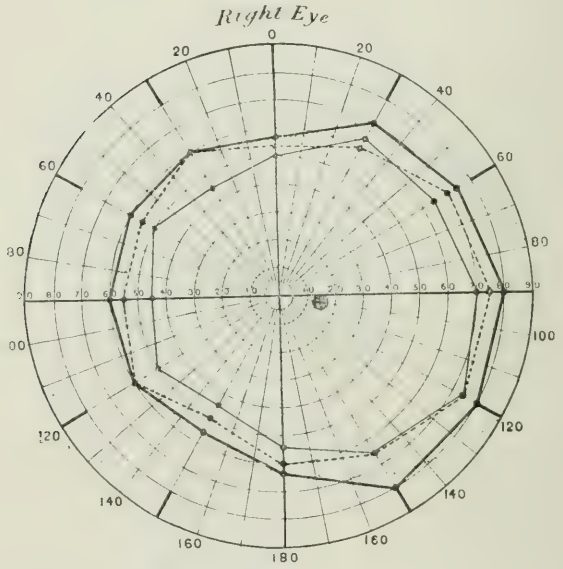
October 23rd.—The xerotic areas were smaller. Ten pills a day were ordered.

29th.—The right eye was free from change, while three tiny white speckles only remained upon the outer side of the left. The latter had disappeared by November 10th, that is to say, after upwards of seven weeks' treatment. Figs. 21 and 22 show the state of the visual fields on November 14th and 24th respectively.

Case 9.—Frank D—, æt. 12, formerly suffered from a purulent discharge from each ear, and was subject every spring to xerosis conjunctivæ. On August 16th, 1897, his condition was as under:—A large, triangular, ridged

patch of xerosis was present in the conjunctiva upon the outer side of each cornea. Hemeralopia was denied; light minimum 4 sq. mm. Read J. 1 with light turned low. The lad was able to get about in a darkened room without

FIG. 23.

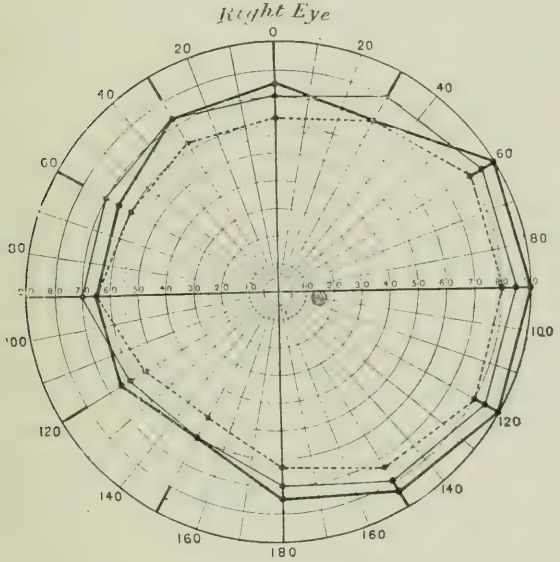


difficulty. Colour vision normal; pupils unchanged; fundus reflexes exaggerated. Fields for white, red, and green all rather reduced (Fig. 23), the red lying internal to the green except at one spot in the superior temporal quadrant of the chart (R. E.). Hæmoglobin 60 per cent., red blood-cells 83 per cent.; white corpuscles normal. On September 1st, six Blaud's pills were directed to be taken daily. Four days later the conjunctival patches were distinctly smaller. On October 23rd, ten pills a day. On October 29th, the xerotic areas were thinner and much less conspicuous; hæmoglobin 75 per cent. Fig. 24 represents the visual field on November 24th, 1897. The conjunctival

changes finally disappeared after rather more than three months' treatment (December 3rd, 1897).

It will thus be evident that although iron may in particular cases cure xerosis quickly, yet two or three months' treatment is in most instances necessary.

FIG. 24.



As pointed out by almost every writer on the subject, cod-liver oil is of service in epithelial xerosis. It probably acts by improving the quality of the blood. Its long-continued administration, as shown by the next case, certainly tends to prevent relapses of xerosis in those subject to the condition.

CASE 10.—Herbert C—, æt. 6, first came under my notice on December 8th, 1892. He was then thin, pale, and gave me the impression of being half-starved; he suffered from internal otorrhœa. A patch of epithelial xerosis was present on the left eye. Upon April 15th,

1893, the conjunctival condition recurred, and persisted for at least four months. In the spring of 1894, and again in the summer of 1895, xerosis was noted. In July of the last-named year the lad was ordered one teaspoonful of cod-liver oil twice a day, a dose shortly afterwards increased to two teaspoonfuls. The xerotic patches had disappeared by October 21st, 1895. The boy at about this time had a succession of boils and abscesses about his face, neck, and body.* There was no relapse in the following year (1896), but the oil was nevertheless continued until the autumn. During 1897 there was no return of the eye ailment. At the present time (January, 1898) the lad is eleven years of age; he looks rather thin, but his height is 51 inches and his weight 67½ lbs. He gives one the impression of being rather chlorotic, yet the percentage of hæmoglobin amounts to 90. His cervical glands are somewhat swollen; otorrhœa is not present.

On the other hand, I never recollect to have seen the conjunctival changes clear up rapidly under the use of oil, although Mr. Simeon Snell, in his communication on the subject, mentions two instances where they disappeared in seven and eleven days respectively. The cases to be next quoted go to show that cod-liver oil is by no means always a specific for epithelial xerosis.

Case 11.—Arthur H—, æt. 6. On June 9th, 1893, xerosis was noted. On July 27th the child was placed upon three drachms of oil a day. Nine weeks later an xerotic patch was still to be seen upon the right eye, and this did not disappear until the oil had been administered for three months in all.

Case 12.—William H—, æt. 12. On September 12th, 1893, a small patch of xerosis was found in the usual place, namely, in the temporal part of each palpebral

* Hippocrates noted the fact that a spontaneous cure of night-blindness sometimes followed an eruption of boils about the face or head.

fissure. The xerotic changes were not to be seen on December 12th, or three months and two days after treatment was commenced.

Case 13.—Albert W—, æt. 9. Xerosis noted on July 10th, 1895, and six drachms of oil ordered to be taken daily. As the patches were still present on August 29th the dose of oil was increased to one ounce a day. On September 25th a trace of xerosis (from which the characteristic bacilli were cultivated) still remained in the right eye. Hemeralopia was not present. The lad was red-green blind, probably as a congenital defect. The xerosis had disappeared by October 1st, after about ten weeks' medication.

Numerous other cases of this kind might be cited, but enough has been said to show that however valuable cod-liver oil may be in selected cases, it assuredly does not speedily cure epithelial xerosis. It must not, therefore, be regarded as an infallible remedy.

When definite night-blindness is present along with xerosis, I have found the citrate of iron and strychnine to be a very efficacious medicine, commencing with five-grain doses three times a day.

Pilocarpine is stated by Kühne to have the power in cats and dogs of hastening regeneration of retinal purple, and on that account has been used hypodermically in night-blindness. Kuschbert and Meklenburg report favourably with regard to its action.

From time to time many other agents have been recommended, as, for example, blisters (Bampfield, Baillie), quinine (Sehotschepotjew), eserine (Martin, Fontan), salicylate of soda (Saltini, Manfredi), phosphorus (Dumas), arsenic (Wecker, Landolt), antipyrine (Grandclément), &c. &c.

I have no experience of treating night-blindness by incarcerating sufferers in a darkened room, as advised by Wharton (66), Netter (67), and some other authorities. Nobody can be astonished, however, that patients declare

themselves freed from hemeralopia after a longer or shorter confinement in places of the sort. It would, indeed, be wonderful did that symptom long survive means of so rigorous and penal a kind.

Lastly, it may be added that special attention should be paid to surroundings, diet, and to any constitutional diathesis that may happen to exist. I would insist upon the importance of curing any chronic suppuration, as *otitis media*, that may, with fair probability, be supposed to exercise a bad influence upon the general health.

The conclusions that may be fairly drawn from this paper are, I think, as follows:

1. Epithelial xerosis is not an uncommon affection among poor children in this country.

2. It is exceedingly prone to recur, perhaps for many years, in one and the same subject.

3. It does not entail any serious or permanent mischief, either as regards the eye itself or the body generally.

4. Although it may not be associated with definite night-blindness, still it is always accompanied by signs of *torpor retinæ*.

5. It generally co-exists with a contraction of the visual field for white and colours, and always, so far as my investigations extend, with a transposition of the red and green fields.

6. It coincides with an increase of the retinal reflexes normally present in the eyes of most young subjects.

7. It is probably always associated with a reduction of hæmoglobin, accompanied in some instances by a deficiency in the red blood-cells.

8. It is remotely due to a defect of nutrition, such as may come about under the influence of tubercle, scurvy, hepatic affections, pellagra, deficiency of animal food, or bad surroundings. The dazzling of sunlight in spring and summer is its immediate cause, so that the xerosis bacilli are enabled to effect a lodgment upon the conjunc-

tiva, where they give rise to the peculiar silvery scales characteristic of the disease.

9. Its tendency to spontaneous cure may be hastened by remedies, of which the most important is iron.

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APPENDIX.

Estimation of hæmoglobin in 164 healthy children.

(Tested by means of Gower's hæmoglobinometer.)

Age.	Males.	Females.
1 year ...	83·5 ...	75·0
2 years ...	73·3 ...	—
3 „ ...	70·0 ...	73·0
4 „ ...	73·3 ...	75·0
5 „ ...	73·8 ...	76·3
6 „ ...	74·0 ...	76·4
7 „ ...	74·0 ...	73·7
8 „ ...	79·0 ...	75·0
9 „ ...	77·7 ...	75·2
10 „ ...	78·3 ...	82·4
11 „ ...	76·3 ...	72·0
12 „ ...	91·0 ...	80·4
13 „ ...	81·8 ...	78·4
14 „ ...	77·0 ...	73·0

Number of children examined 164 (ages 2 months to 14 years) { Males, 88. Females, 76.

Average hæmoglobin = 76·62 per cent., *i. e.* males 77·35 per cent. and females 75·83 per cent.

(*January 27th*, 1898.)

Mr. Eales (the Chairman) said they were all very much indebted to Mr. Stephenson for his most interesting paper on a very peculiar disease, and the very concise facts he had elucidated. It was interesting to him personally that Mr. Stephenson had confirmed most of the feelings he had on the subject—that it seemed to be peculiar to ill-nourished and half-starved children in the lower walks of life, and occurred mostly in summer. He was also pleased

that Mr. Stephenson looked upon iron as especially indicated, as he had always found it beneficial.

Mr. Arnold Lawson said he did not hear Mr. Stephenson allude to the similarity of the bacillus of xerosis to the diphtheria bacillus; both were stained by methylene blue, and recent microscopical specimens of both bacilli were morphologically indistinguishable. Of course to distinguish them there were several points known. The brood-cell of the diphtheria bacillus grew rapidly, colonies of it being seen twelve to eighteen hours after the culture, whereas the xerosis bacillus did not make its appearance until thirty-six to forty-eight hours. Again, on the potato the xerosis bacillus refused to grow at all, while the diphtheria bacillus attained its largest size in that medium. Finally, the diphtheria bacillus was very pathogenic as tested on guinea-pigs and other animals, while no results followed the injection of the xerosis microbe into the same animals. He, like Mr. Stephenson, had obtained pure cultures of the bacillus of xerosis in epithelial xerosis, in which disease these bacilli were so plentiful as often to swamp every other organism; and it was therefore curious that no pathogenic effect could be traced to them, though there was strong reason to think they had something to do with the condition.

Dr. J. W. Eyre said Mr. Stephenson had given a description of the organism of xerosis entirely omitting the characteristic appearance of the real xerosis bacillus which was described by Kuschbert and Neisser. It was possible that he might have found some other organisms which actually gave rise to the condition. Moreover, Mr. Stephenson said that the bacillus on which he had been working grew only on agar and serum. Although this was true of the first cultures, after the organisms had been subcultivated several times the saprophytic characters were quickly regained, and growth took place on ordinary media, including gelatin. Although the xerosis bacillus occurred in very large numbers in the conjunctival sac in an eye which was affected with xerosis, it was by no

means surprising, because it occurred in all sorts of diseased conditions of the eye. Mr. Arnold Lawson had mentioned that in the conjunctival sac a large number of organisms were normally found, which was partly true; but in any one tube inoculated from the eye one found one, two, or perhaps three organisms, very rarely more. If a dozen tubes were so inoculated from the same sac, each tube might contain a pure culture of a different organism, but it would be quite by chance if an xerosis bacillus was the first obtained. The presence of the xerosis organism was by no means characteristic of the disease in his experience, but was found in every diseased condition of the eye, simply as a casual inhabitant of the sac, which did absolutely no harm.

Mr. Stephenson had also suggested altering the surroundings of animals, with a view to raising the virulence; he (Dr. Eyre) had tried that in many experiments, inoculating the xerosis bacillus into the eye, mucous membrane, and various parts of the body of rabbits, guinea-pigs, mice, and birds, at the same time injecting into the circulation various toxines which might lower the resistance of the tissues; but in no case had he obtained any positive results.

To go back to the clinical picture, in one case he excised portions of the diseased conjunctiva from an eye which presented a patch of epithelial xerosis on either side of the cornea, but, contrary to expectation, he did not find any xerosis microbes in the depth of any of the sections. The lesions consisted of necrosed epithelial cells, all flattened out, very hard and curdy looking, taking the stain badly, and with thickened conjunctival epithelium underneath.

Mr. Drake-Brockman said he would like to endorse the Chairman's remarks as to the indebtedness of the Society to Mr. Stephenson for his graphic paper. He (Mr. Drake-Brockman) had observed the disease for many years past in the East among children who attended the clinique of his hospital. Situated as he was, without the opportunity of

consulting a library or referring to his medical brethren, he thought at one time that the disease which had been described, and which was always associated with night-blindness, was a discovery of his own. He was accordingly thinking of writing something on the subject, when he saw that Mr. Snell published a contribution which somewhat took the wind out of his sails. Until he came to that meeting he had no idea that so much had been written on the subject. He was glad that Mr. Stephenson agreed that the disease occurred among children who had an inferior dietary. He had noticed that the condition was present in individuals who had large numbers of round-worm, and that it occurred in children whose parents had a syphilitic or tuberculous taint. The parents usually brought their children, primarily, on account of the night-blindness. The description which Mr. Stephenson had given was to the life. He (Mr. Drake-Brockman) usually described the condition to his students as a little frothy foam, whipped up by the action of the lids over the surface of the conjunctiva. The disease was towards the external canthus, corresponding to the external rectus muscle. Ophthalmoscopically he invariably found the retinal reflexes were most marked. He had found adults suffering from the same condition, and always in those who were recovering from some depleting illness. During the famine of 1878–9, which raged in the Madras Presidency, the famine-stricken people showed this condition of things, associated with a pigmentation along the mucous membrane bordering the teeth, especially of the lower jaw. He had found iron most serviceable in the treatment, as had Mr. Stephenson, but he (Mr. Drake-Brockman) never gave any tonic until he had removed the parasites from the intestine. In speaking to a medical man in Colombo who interested himself in diseases of the eye, he heard that the parasite of the duodenum (the *Ankylostoma duodenalis*), which had since been so much talked about, was always present in connection with the disease under consideration. That gentleman invariably administered

menthol to expel the parasites, before he gave any tonic for the blood.

Mr. Stephenson, in reply, reminded members of the Society that time compelled him to read only extracts from his paper. If he had read it fully, Mr. Arnold Lawson would have been satisfied with his reference to the morphological similarity between the xerosis parasite and the diphtheria bacillus, though he believed the resemblance had been somewhat exaggerated. He was, however, unable to agree with Mr. Lawson as to the xerosis bacillus not making any perceptible growth in tubes for thirty-six to forty-eight hours. He had found, on the contrary, that the bacillus grew in sixteen hours at the body temperature, and that was the result of a large number of experiments. Of course it was very possible he (Mr. Stephenson) might be mistaken in this organism; the same remark applied to other people who worked at bacteriology, although he would be the last to suggest that Dr. Eyre could possibly be mistaken in the matter upon which he spoke.* He was pleased to hear Dr. Brockman's remarks. He had some doubt whether he ought to mention retinal reflexes to the Society, as it was a difficult point to assure one's self that they were increased in the disease.

* After examining the microscopic specimens shown by Mr. Stephenson, Dr. Eyre was satisfied that the latter were those of xerosis bacilli.—S. S.

3. *Epithelial xerosis in natives of India.*

By Surgeon-Captain H. Herbert.

The photograph and microscopic preparations which I wish to show are examples of a general degeneration and chronic inflammation of mucous membranes, very commonly met with in Bombay among the poorest classes. So common is this that in four months, June to September, 1896, I was able to tabulate 100 consecutive cases.

Epithelial xerosis is found in debilitated persons exposed to strong glare and in marasmic infants. It shows itself mainly in the formation of greasy patches on either side of the cornea, and the collection of cast-off epithelial cells and Meibomian secretion which is known as "foam." In infants the cornea is liable to rapid suppurative destruction. When the condition is well advanced the patients are always in a bad state of health, due to want of food or dysentery, and other mucous membranes are sure to be affected.

By far the commonest site of the disease is an area outside the cornea, but occasionally much more extensive patches are seen. The patches, however, tend to be cast off by inflammation of the conjunctiva, so that after suppuration of the cornea, which frequently occurs, there may be nothing but a little characteristic pigmentation to show the true nature of the case, and this is absent in white-skinned races. This pigmentation is a very marked feature, and is nearly always present. It sometimes occurs in strips, chiefly marked below the cornea, in the fornix, and on the lower lid; on the upper lid there is usually but very little. In the most severe cases the conjunctiva is more uniformly pigmented.

As the condition improves a good deal of the pigment becomes absorbed, but some usually remains permanent.

As is only to be expected, the feeble resisting power of the degenerated conjunctiva is easily overcome by other organisms, and we find that after a time a very

large number of cases develop trachoma, though the cases are not severe and do not lead to entropion.

Corneal changes are common; usually some opacity or dulness is observed, caused by infiltration in the cornea itself, or by thickening or other changes in the epithelium. In more severe cases we find acute suppurative ulceration, which may destroy the entire cornea.

Phlyctenules come more frequently in xerotic than in healthy conjunctivæ.

In nearly all the cases bad general health was present, with marasmus, diarrhœa, fever; some affections of the mucous membrane of the nose, throat, or larynx; epithelial *débris* in the urine, &c.

The cause of the affection is probably in all cases faulty feeding, either in quantity or quality.

Treatment consists in improving the general health and bandaging the eyes, unless some corneal complication makes this inapplicable.

(*Card specimen. May 5th*, 1898.)

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4. *Pemphigus of the conjunctiva.*

By Charles Wray.

The patient is a strong, healthy-looking woman of 54. She has never had syphilis and has enjoyed good health, but has suffered for many years from psoriasis of the knees and elbows, and was operated on for malignant disease of the breast at Guy's in 1885.

She has never had shingles or any similar diseases, but her brother suffered from shingles some years ago.

The trouble began with soreness of the hard palate due to blisters. This she attributed to an ill-fitting artificial tooth-plate. A month later her eyes began to trouble her (January, 1898). At this time she had six or eight superficial ulcers in the hard palate, and a very mild follicular conjunctivitis. It was supposed the ulcers on

the palate were of specific origin. They showed little tendency to heal, but remained superficial. Hydrarg. and Potassii Iodid. were administered, and quinine and salicylic acid lotions applied to the conjunctiva of the eyelid.

Fourteen days later the appearance of the conjunctiva resembled a mild diphtheritic conjunctivitis. The condition of the palate remained the same, and no sores were found elsewhere. (The nose, gums, and throat were examined.) The patient was then lost sight of for several months.

In May the appearance of diphtheritic conjunctivitis had disappeared, and there was extensive symblepharon in both eyes, affecting the lower lids and restraining the movements of the globe. The upper lids were free from adhesions.

(*Card specimen. June 9th*, 1898.)

In June the adhesions were snipped, and strips of pediculated conjunctiva brought down from the globe and attached to the raw surfaces. The result has been greater mobility of the globe, and withdrawal of all traction on the cornea when the eye is moved from side to side. Ulcers preceded by blisters have recently (August 4th) attacked the gums, but the inner surface of the cheek is still unaffected.

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5. *Recurrent conjunctival membrane.*

By Rayner D. Batten.

Edw. B—, æt. 44. On the conjunctival surface of the upper lid in the right eye there is a dry white membranous patch, with one or two black spots on it (probably coal dust). The surface appears greasy, and tears and watery solutions run off it. The margins are clear and distinct. The membrane is fairly easily scraped off, leaving an apparently smooth surface. The membrane has been removed four times, and each time has recurred and increased in size.

July, 1898.—The patient attended at the Western

Ophthalmic Hospital regularly for nearly six months, during which time almost every variety of antiseptic and caustic was applied, but the growth always returned in about a week.

Finally I scraped off the membrane and painted the surface with pure carbolic acid, keeping the lid dry with blotting-paper.

The first application reduced the patch to one third its size. Three weeks after the membrane formed again on a much smaller area. It was painted again with carbolic acid, and the patch was reduced to a minute white speck, and caused no further inconvenience.

The membrane was examined microscopically, and portions were cultivated, but no evidences as to the nature of growth were obtained in either case.

From the way in which the affected area healed from the circumference, the membrane still forming on the central part, I presume that membrane was only an exudation from the affected area, and not a true membranous growth.

(*Card specimen. December 9th,* 1897.)

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6. *Œdema of the conjunctiva, due to obstruction of the lymph streams.*

By W. T. Holmes Spicer.

Case 1. *Acute œdema of the conjunctiva, with enlargement of the pre-auricular and cervical lymphatic glands.*—P. W—, æt. 33, was first seen on July 2nd, 1895. The left eye had been irritable many days; he had been driving about London a good deal, and had been much annoyed by dust from the wood pavement, some of which had got into his eye.

On examination a small black foreign body was found lying in the lower conjunctival fold; it was removed easily by a piece of blotting-paper. There was moderate injection

of the conjunctiva, slight tenderness, and a general enlargement of the follicles of the lower lid.

He was in good health at the time, but he considered himself rheumatic; he had had rheumatic fever about ten years before, but had been fairly free from rheumatism for many years.

He was given a simple lotion of boric acid.

On July 4th the glands in front of the ear and those of the neck on the left side became enlarged and tender; he had pains in his limbs, and the temperature was 100°. Salicin treatment was begun.

Four days later he was better, but the eye was more painful and the glands were still enlarged.

On July 12th he went away to the sea-side.

On July 17th he returned home, as the eye was more painful and his throat had become inflamed. There was slight chemosis of the ocular conjunctiva, the glands in the neck were more enlarged, and he had follicular tonsillitis. He was seen at this time by Mr. Alfred Willett, who looked after his throat.

July 19th.—The condition of the eye had got much worse. The œdema of the conjunctiva had increased considerably; it stood up around the cornea to the height of several mm., and at the lower part it hung out from between the closed lids as a loose yellow gelatinous bag. The cornea was clear, there was no iritis, the pupil dilated fully with atropine; the fundus of the eye was normal.

The tonsils were covered with white sloughy points; there was a discharge of blood-stained fluid from the nostril; the gland in front of the ear was enlarged, and there was a chain of enlarged glands running down the posterior border of the sterno-mastoid. His temperature was raised during all this time, but was never higher than 102°.

His general treatment was salicylates, and locally lead lotion was applied to the eye.

It was very doubtful what was the matter with the patient; there was evidently an acute septic infection of

an unusual kind present, and the suggestion was made that it might be glanders.

On the next day, July 20th, Mr. Nettleship saw the patient, but the swelling had already begun to decline, and from this time the improvement was rapid, and recovery eventually complete.

Case 2. *Acute œdema of the conjunctiva with enlargement of the pre-auricular gland.*—Sydney W—, plasterer, æt. 36, came to Moorfields on November 21st, 1896. The left eye had been inflamed two days; he had been away from work with a sore throat one week. He had had no injury to the eye, and did not remember having had a foreign body in it. He had recently had rheumatism in many limbs; he had had rheumatic fever eleven years before, was laid up fifteen weeks with it, had had no recurrence since. He never had any venereal disease.

There was moderate general injection of the conjunctiva of the globe, with scarcely any discharge; there was a good deal of chemosis of the ocular conjunctiva all round the cornea, but especially at the lower part, where it filled the interval between the globe and the lid. The pupil was normal in action, and the vision was unaffected.

There was a good deal of tenderness and enlargement of the gland in front of the ear.

His temperature was 100·2°, and he had follicular tonsillitis. With protection, boric acid, and salicylates internally the swelling subsided; two weeks later there was slight congestion of the conjunctiva only, and the inflamed gland had become quiet.

Case 3. *Solid œdema of the conjunctiva due to obstruction of the lymphatic circulation.*—Jessie E—, æt. 21, was first seen on October 30th, 1897. The condition of the eye had only been noticed in the previous few weeks. Two years before she had had swelling of the gland in front of the right ear, and of the whole right side of the face; it was called erysipelas, but it lasted six months.

A series of abscesses formed, which opened and discharged of themselves, and eventually healed up, leaving scars.

There was, when seen, some puffiness of the lids on the right side; there was considerable solid œdema of the ocular conjunctiva, which was raised to the amount of several millimetres round the cornea, and was very tense; the cornea appeared sunken in the ring of swollen conjunctiva around it; the swelling extended back as far as the equator. It did not pit on pressure, and was perfectly pale and bloodless.

There were several scars in the neck and in front of the ear from old glandular abscesses; no enlargement of lymphatic vessels could be traced between the eye and the neck. There were also some scars on the left side of the neck from previous abscesses, but no affection of the eye on that side.

The fundus of both eyes was normal.

V. { R. $\frac{6}{6}$ Hm. 4 D. J. 1.
L. $\frac{6}{6}$ Hm. 4 D. J. 1.

There was no history of any other affection except of the glands. The case was watched for some months and underwent no change; she was then placed upon a course of mercury and iodide of potassium, which resulted in no change. She was last seen in May, 1898, and the conjunctiva presented the same appearance as in the previous October.

(*Card specimen. December 9th,* 1897.)

The first two cases just narrated belong to the same class, and present quite similar features, only differing in severity. To recapitulate these features—a sudden attack of severe œdema of the conjunctiva with only mild inflammatory appearances; enlargement of the lymphatic glands which first receive the lymph from the eye; acute tonsillitis with fever and raised temperature; a previous history of acute rheumatism.

The interpretation which best fits in with all the circumstances is, I think, the following:—A poison of some

kind was received into the conjunctival sac, and although the local inflammatory reaction was not great, it led to a marked enlargement of the lymphatic glands which first receive the lymph as it comes from the eye; this brought about an obstruction to the flow of lymph from the eye. The coincidence of the acute tonsillitis and enlargement of the cervical glands lower down added further hindrance to the lymph-flow; the result was distension of the subconjunctival tissue interspaces and production of the extreme œdema in Case 1, and of the more moderate œdema in Case 2.

Further evidence of the possibility of the occurrence of this sequence is given in Case 3, which shows the result on the conjunctiva of obliterating most of the lymphatic channels passing from the front of the eye to the thorax. A slow gradual distension of the subconjunctival cellular interspaces was produced by the accumulation of the more solid parts of the lymphatic fluid, resulting in a condition which might well be called elephantiasis of the conjunctiva.

A further point of interest lies in a possible explanation of those rare cases shown in former years at this Society by Brailey, Nettleship, Adams Frost, and Donald Gunn.

Brailey's case ('Ophthal. Soc. Trans.,' ix, p. 82) was called "peculiar solid thickening of the ocular conjunctiva in a child, apparently tubercular." This was limited to one eye, and on the same side of the neck there was a large swelling due to subacute lymphadenitis. Nettleship's case ('Ophthal. Soc. Trans.,' xiv, p. 68), shown by Donald Gunn, was called "syphilitic (?) subconjunctival infiltration;" no mention was made of the condition of the glands.

In Adams Frost's case, shown by Donald Gunn ('Ophthal. Soc. Trans.,' xiv, p. 68), headed "syphilitic (?) infiltration of the conjunctiva," there was enlargement of the pre-auricular gland and of the cervical glands.

In Donald Gunn's case ('Ophthal. Soc. Trans.,' xiv, p. 71), headed also "syphilitic infiltration of the ocular conjunctiva," there was enlargement of the pre-auricular

and cervical glands. That is to say, with one exception in which they were not mentioned there was marked enlargement of the lymphatic glands. It is possible that these cases may have been tubercular or syphilitic, as the case may be, in so far as the enlargement of the glands was concerned; but it is also probable that the condition of the conjunctiva was secondary to and dependent on this enlargement, and was not tubercular or syphilitic in the sense of being a peculiar or special manifestation of those diseases.

(*June 9th*, 1898.)

Dr. BATTEN mentioned the case of a girl æt. 12, who came with a rather acute conjunctivitis in the right eye, but little else. A week afterwards she came with marked œdema of the conjunctiva, the globe became fixed and proptosed. There was enlargement of the glands of the neck on the same side, and a slight rise of temperature; no special tonsillitis, nor any evidence of rheumatism. The condition subsided gradually, and the eye ultimately recovered its movements.

There was one other case which he thought was analogous to those of Mr. Spicer's, viz. that of a woman of about 30, who came with a slight inflammation of the conjunctiva, which afterward became intensely œdematous. The œdema was so intense that the conjunctiva overlapped the cornea. The lids also subsequently became intensely œdematous. She was unable to raise the lid, and the eye was fixed and proptosed. The ocular movements were apparently limited by the intensity of the œdema. Thinking that there must be some intra-orbital cause for such an intense œdema, an exploratory incision was made into the orbit, but no cause was found. Soon after the other eye became œdematous exactly in the same way. There was no evidence of rheumatism, but the condition subsided rapidly on giving salicylate of soda in large doses. He had had one or two similar cases since, but not so marked as that, and they had subsided under the same

treatment. He did not quite follow Mr. Spicer as to the cause of the lymphatic obstruction. He understood Mr. Spicer that it was limited to the conjunctiva. In his (Dr. Batten's) cases the œdema was more than could be associated with simple lymphatic obstruction.

Mr. Bass thought it somewhat suggestive that in Mr. Spicer's cases there existed follicular tonsillitis. A possible explanation would, he thought, be that there existed slight conjunctivitis, causing difficulty in opening the lids; and the patients, as was usual in such circumstances, were accustomed to moisten the lids with their own saliva. If there were any infective process going on in the pharynx, it would be a very direct means of inoculating a previously inflamed conjunctiva.

Mr. Holmes Spicer, in reply to Dr. Batten, said possibly the difference between Dr. Batten's and his own cases was to be explained by the different severity. Dr. Batten's cases were much more inflammatory than his own, the latter being more dependent on lymphatic obstruction. The first case was treated vigorously with salicylate, and seemed to improve under it.

Replying to Mr. Bass, the difficulty in accepting his explanation was that the conjunctival affection started before that of the throat, and the throat only seemed to aggravate it. His patient was so convinced that he got his trouble from the wood pavements, that he got compensation from the accident company in which he was insured.

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7. *Large subconjunctival cyst.*

By Simeon Snell.

Fred I—, æt. 23, joiner, was admitted into the Sheffield Royal Infirmary on May 14th, 1898, with a cyst lying under the conjunctiva of the right eye, to the outer side of the eyeball, under cover of the lower eyelid.

The cyst had been noticed since birth. Patient knew when he was aged about seven or eight, going to school, that there was a small lump inside the eyelid. It looked, he says, like a blister or a scald, and was about the size of a pea. It remained transparent, and did not much alter

Fig. 25.

in size until he received a blow from a clog on it last August (1897). It enlarged immediately after the blow and became discoloured, as it appeared at the time of his admission. It never had been dark before.

Present condition.—The cyst is practically concealed by the lower eyelid, but the swelling in the lid it occasions hardly gives an idea of the size of the cyst; its upper part can barely be seen above the edge of the eyelid. When the eyelid is drawn down the cyst bulges out as a dark blackish-blue swelling about the size and shape of a hazel-nut. It is translucent, somewhat circumscribed at its base, and vessels run from the conjunctiva over it.

It is attached to both the palpebral and the ocular conjunctiva.

May 18th.—Cocaine was instilled and the cyst was dissected out entire, the conjunctival wound being closed with horsehair sutures.

I exhibit a water-colour drawing of the case, as well as photographs. Mr. Treacher Collins kindly examined the specimen for me, and his report is now appended.

Report on cyst received from Mr. Snell, June, 1898, *in formol.*

A dark grey-coloured, oval cyst, measuring 17 mm. by 13 mm. On section a thin, brownish, turbid fluid escaped, which did not coagulate on boiling, but became opaque and flocculent on the addition of hydrochloric acid. Microscopically it is seen to contain a number of fine amorphous granules.

Sections of the walls of the cyst examined microscopically show it to be lined throughout by a single layer of endothelial cells. External to the endothelium is some moderately dense fibrous tissue containing blood-vessels. In places this fibrous tissue is infiltrated by collections of small round cells with deeply staining nuclei. On the external surface of the specimen, over a portion of its extent, is seen the laminated epithelium of the conjunctiva. This in some parts of its extent is only separated from the endothelial lining of the cyst by a thin layer of fibrous tissue containing blood-vessels. Immediately beneath the conjunctival epithelium there are, in places, areas of dense round-celled infiltration.—E. Treacher Collins.

(*July 8th,* 1898.)

III. DISEASES OF THE CORNEA.

1. *Case of keratitis.*

By John R. Rolston.

J. W—, æt. 55, baker.

Previous history.—Subject to inflamed eyes when a boy, and for several years has had "rheumatics." No history of syphilis.

Present history.—Both eyes have been failing for twelve months. Up to last twelve months could see to read newspaper. No pain.

Condition when seen by me on November 22nd, 1897, and also when shown to Society in January.—In both corneæ there are scattered in cornea propria numerous small nebulous bodies having the appearance of small pieces of cotton wool. These are grouped in the centres of each cornea, leaving the peripheral part quite clear. In one or two places the anterior epithelium seems to be pushed forward so as to form small, clear prominences. There is no pain, nor any reaction with fluorescin.

R. V. = $\frac{4}{60}$.

L. V. = $\frac{6}{60}$.

Dr. Lawrence Fox has examined him, and reported to me that there is no organic lesion, and general health good.

(*Card specimen. January 27th,* 1898.)

July 11th, 1898.—By my request he has called on me to-day. He says that his eyesight is much clearer, and that he can read newspaper well. His distant vision to-day is as before, and with each eye J. 4 at six inches.

The corneæ are in much the same condition as before, except that the opacities are not so apparent; but with oblique illumination and with corneal magnifier the opacities are not so regular, and are finer and less dense. There is no raising of anterior epithelium, and no reaction with fluorescin.

He has refused any operative measure, and I have therefore not been able to examine microscopically any of these bodies, as was suggested when he was shown at the Society.

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2. *Operation for transverse calcareous films of both corneæ.*

By Poulett Wells.

This patient was shown to the Society in 1896, and the condition is figured in a coloured plate in the 'Transactions' of that year. The films were removed chiefly by means of a small keratome, four operations being done on the right cornea and two on the left. On the left cornea at the outer part a small piece of the film has been left, which shows well its original appearance.

Vision before operation in June, 1896:

R. $\frac{6}{18}$ + 0·75 = $\frac{6}{9}$.

L. $\frac{6}{6}$ + 0·5 = $\frac{6}{6}$.

Vision after operation in January, 1897:

R. + 1 D. cyl. 50° = $\frac{6}{6}$ part.

L. + 2·75 $\bar{c}$ − 0·5 cyl. 80° = $\frac{6}{6}$.

(*Card specimen. January 27th*, 1898.)

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3. *Epithelioma of the cornea with pigmented stroma.*

By C. Devereux Marshall.

Thomas W—, æt. 79, was admitted at Moorfields under Mr. Nettleship on December 1st, 1897, with the following history. In March of that year he noticed a blister at the right corneo-scleral junction; this was cut off.

He was treated elsewhere with lotions, &c., but the mass has gradually increased in size.

The sight has always been excellent, and he has been more or less at sea for fifty-six years.

At the upper part of the right corneo-scleral junction and extending on to the sclerotic is a raised growth measuring 10·5 × 8·5 mm. Rather more than a third of the upper and outer part of the cornea is involved. It is 2 mm. in thickness. It is of a dark mottled colour.

Microscopic examination.—The growth is an epithelioma, containing a fair amount of connective-tissue stroma which has a good deal of pigment in it. There is some blood extravasated between the cells, and there are a few vascular spaces. The growth invades the sclerotic, and its advancing part is preceded by some round-cell infiltration.

(*Card specimen. March 10th,* 1898.)

IV. DISEASES OF THE CRYSTALLINE LENS.

1. *Congenital misplacement of lenses; spontaneous dislocation into the anterior chamber; replacement of lens into the vitreous by operation; recovery of perfect vision.*

By Thomas H. Bickerton.

Thomas F. C—, æt. 28, clerk.

Previous history.—Mother states that patient has been short-sighted since infancy. Special inquiry elicited the fact that "when about fourteen years of age he was subject to giddiness, which sometimes caused him to fall violently forward, often hurting his forehead on the street pavement." At the age of eighteen he had "congestion of the brain," and when nineteen he began glasses for near work only. When twenty-three years old he obtained, from an optician, spectacles (R. — 6·50 sph., L. — 6 sph.) which for the last five years he has worn about seven and a half hours per day during his clerical work.

Symptoms.—Suffers greatly from headache with sensations of fulness, weight, and heat in the head, and burning and aching of the eyes.

Date of first visit.—December 3rd, 1887.

Condition on first visit.—In each eye there was general tremulousness of the iris, with dislocation of the lens backwards into the vitreous. (I regret to say that accurate notes of the local condition were not at this time taken.)

Distant vision.—R. E. $\frac{6}{0}$ sph. + 10 $\frac{6}{6}$ 4 letters. L. E. $\frac{6}{0}$ sph. + 10 D. $\frac{6}{24}$ 2 letters, $\frac{6}{18}$ 1 letter.

Near vision.—On assuming the reading attitude the

refraction of the eyes was entirely altered, evidently by the tilting forwards of the crystalline lenses.

Right eye.—Without a glass he read J. 1 easily at from three and a half to four inches, and with his reading-glass (− 6·50 sph.) he also read J. 1, though not quite so fluently.

Left eye.—Without a glass he read J. 1 well at three or four inches, but with his reading-glass (− 6 sph.) he could only read J. 4.

Vision on December 12th, 1887 (after a week's complete rest).—*Right eye :* + 10 sph. $\frac{6}{6}$ 3 letters. Without glass J. 1 easily at three and a half inches, and with his reading-glass (− 6·50 sph.) J. 1 also easily, but slightly further off.

Left eye : + 10 sph. $\frac{6}{24}$ 1 letter. J. 1 easily at three and a half inches with or without his reading-glass (− 6 sph.). He was ordered + 10 spherical—both eyes—for distance only, and to discontinue his glasses for near work.

On March 10th, 1888, vision of the right eye had improved with his + 10 sph. to $\frac{6}{6}$ perfectly, and in the left to $\frac{6}{18}$ perfectly ; but on now assuming the reading posture the crystalline lenses did *not* tilt forwards (as on December 3rd, 1887), and he now required a spherical + 14 in both eyes to enable him to read J. 1, which with these lenses he did easily.

On July 7th, 1888, the distant vision of the left eye had improved with + 11 sph. to $\frac{6}{6}$ 2 letters. I did not again see the patient until December 26th, 1893, when he presented himself and gave the following further history.

Further history.—His vision with the correcting glasses remained unchanged for five years.

In July, 1893, after washing his face, he became suddenly blind in his left eye. Consulted a doctor, who ordered a lotion. On rising next morning the vision of the eye was restored.

In November, 1893, he had a second similar attack, but this time in the right eye, also occurring after washing

his face. He saw the same doctor, used a similar lotion, and rose next morning with the sight again restored.

On December 13th, 1893, blindness again attacked the left eye suddenly after washing, and he again sought relief. This time the doctor, in addition to ordering a lotion, put in some eserine drops. On waking next morning the patient found that the eye was still blind. For the next few days eserine was instilled daily, but dull aching pain in the eye, with increasing redness and loss of sleep forced him to seek further advice.

Condition on December 26th, 1893.—*Left eye.*—There is general slight congestion, the cornea is faintly hazy. The anterior chamber is occupied by the clear crystalline lens, which in five sixths of its circumference lies in front of the iris. The iris could only be seen at its inner part where it lies in front of the lens. The optic disc can be seen, but very hazily, and no details can be made out. T. +. Vision reduced to light and shade.

Operation.—The by no means satisfactory results accruing from extraction in such cases, and the knowledge that the presence of these moveable lenses in the vitreous had been so well and so long tolerated, suggested the alternative plan of attempting reposition. On December 30th, 1893, after free application of atropine, with the assistance of Dr. Richard Williams, I made a small corneal incision (under cocaine) with a keratome, at the outer corneo-scleral margin, to reduce tension, and tried by finger pressure applied through the lid to press the lens back through the pupil. This failing, I introduced a spatula into the anterior chamber, and on elevating the handle the lens slipped bodily backwards into the vitreous chamber. A pad and bandage were then applied.

December 31st, 1893.—Has had no pain. Best night for a fortnight, cornea streaky; a drop of blood on iris opposite point of incision; pupil $4\frac{1}{2}$ mm.

January 2nd, 1894.—Signs of iritis, so atropine instilled. The case made an uninterrupted recovery, and his previous good vision was rapidly restored. Pre-

cautions were given him as to attitude, in order to avoid recurrence.

On June 9th, 1897, patient came to show himself. He has had no further trouble, and has discharged his clerical duties uninterruptedly since that date. His vision to-day is—R. E. $\bar{c}$ + 12 sph. $\frac{6}{5}$ 8 out of 9 letters. L. E. $\bar{c} \frac{+ 12 \text{ sph.}}{- \cdot 75 \text{ cyl. } 20^{\circ}} \frac{6}{5}$ every letter and astigmatic clock perfect.

In looking through the literature of the cases of congenitally displaced lenses which have been recorded (and several most interesting cases are fully reported in the Moorfields Ophthalmic Hospital Reports and in the 'Transactions' of this Society), the following points are those to which attention has been directed by the different observers.

1. *Influence of heredity.*—These cases are generally congenital and often hereditary, and it is interesting to notice that when hereditary the defect is transmitted to the eldest child or children, and shows a marked selection for the male members of the family (Dixon, 'Oph. Rep.,' vol. i, p. 54; Stanford Morton, 'Oph. Rep.,' vol. ix, p. 435). In the present case there is no history of heredity, and the patient (a male) is the only child.

2. *Refraction.*—Most of the recorded cases have come under notice on account of near-sightedness, and it has been stated that such congenital condition is usually associated with myopia and amblyopia. But in most of the recorded cases no myopic crescent has been seen, and where glasses have been ordered convex lenses as a rule have only been of benefit. The amblyopia has been attributed to the "reception from birth of confused and imperfect images upon the retina," but reference to cases shows that the reading of J. 1 has been the rule rather than the exception. In this case there is no myopia, and there is perfect visual acuity. (Vision = $\frac{6}{5}$ and J. 1 with each eye.)

3. *Size of eyeballs.*—There does not appear from the

recorded cases to be any definite relationship between the size of the eyeball and this congenital malposition of the lens, nor does the abnormal situation of the lens appear to be associated with any interference with general ocular growth. In Streatfield's case ('Oph. Rep.,' vol. viii, p. 394) the eyeballs were rather prominent, and this is so in the present instance.

4. *Iris.*—In all the cases there has been local tremulousness and recession of the iris, limited, however, to the part unsupported by the lens.

In this case, as the lens is not anywhere in apposition with the iris, there is general tremulousness and recession of this structure, so that the iris hangs on the same vertical plane, and the anterior chamber is deeper than normal throughout.

5. *Pupil.*—In most cases the pupillary area is in part occupied by the displaced lens, the margin of which can be seen with or without mydriasis. In this case the pupil is uniformly black, the lens in the normal position of the eye being quite out of relation with it, even with the pupil widely dilated. In this case also the pupils are large, varying from four to six mm.

6. *Direction of displacement.*—An analysis of twenty eyes with this congenital condition shows that—

In 7	eyes	the displacement	was inwards.
6	,,	,,	up and in.
4	,,	,,	up.
2	,,	,,	down.
1	,,	,,	up and out.
20			

In the case under consideration the displacement is backwards and downwards, a prostration backwards of the lens having taken place, so that on looking downwards and inwards with the ophthalmoscopic mirror one is looking down upon the anterior surface of the crystalline lens, which is evidently lying in the vitreous.

7. *Characters of displaced lenses.*—(*a*) *Mobility.*—Out

of twenty eyes the lenses were moveable in two (Mr. Cross's case); stated definitely to be immoveable in six eyes; while no remark as to mobility is made in the remaining cases.

In this case (March, 1897) the left lens appears to be slightly moveable, while there is a doubt on this point as to the right lens.

(*b*) *Size.*—In twelve eyes of which illustrations are given by Stanford Morton ('Oph. Rep.,' vol. ix, p. 435) the lenses appeared to be of normal size and shape.

In Holmes Spicer's case ('Oph. Trans.,' vol. x, p. 194) he surmises "that the lenses have maintained their early globular shape while the eyes have developed normally."

In this case, from the fact that the left lens completely filled the anterior chamber when dislocated therein, we may infer that the lenses are of normal dimensions.

(*c*) *Colour and transparency.*—In Stanford Morton's twelve eyes the lenses were uniformly milky. In other cases they are stated to be transparent or faintly greyish.

In this case the right lens is perfectly transparent, while the left, nearly four years after operation, is greyish with a few minute opacities on its anterior surface, near the periphery.

(*d*) *Margin.*—In Stanford Morton's cases the lenses had a "good round outline;" in Holmes Spicer's case the left lens had an irregular margin, bearing two blunt elevations. In the present case both lenses have a perfectly regular black outline, without the golden reflex under concentrated light observed in some of the cases.

(*e*) *Suspensory ligament of lens.*—Stanford Morton calls attention to the visibility of this in most of his cases, the membrane spreading radially from the lens to the iris. In the present case in both eyes careful oblique illumination shows delicate snow-white horizontal folds floating freely and apparently at some depth in the vitreous.

8. *Association with choroidal degeneration.*—This relationship has been observed, and in the present case there are peripheral patches of old choroidal atrophy.

Remarks.—1. But for the instillation of eserine it is probable that the recumbent position would have restored the lens to its usual position in the posterior chamber, as had occurred on the previous occasions.

2. The point which suggested the unusual procedure of attempting reposition of a lens dislocated into the anterior chamber were, (*a*) that reposition had occurred spontaneously on two prior occasions with restoration of perfect vision, (*b*) that extraction of a lens from the anterior chamber generally entails some loss of vitreous and impairment of vision, (*c*) that even if the lens became cataractous its usual position in the lower portion of the vitreous below the visual axis would entail no impairment of vision, and (*d*) that if rupture of the capsule occurred during couching, absorption would probably take place.

3. That considering (*a*) the presence of this congenital affection, (*b*) the existence of choroidal atrophy, (*c*) the occurrence of spontaneous dislocation into anterior chamber, (*d*) the operation undertaken, and (*e*) the length of time which has now elapsed, and the ability of the eyes for the long-continued and close near work required of the eyes daily, the visual acuity is remarkable.

(*October* 21*st*, 1897.)

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2. *On the pathogenesis of anterior polar cataract.*

By E. Treacher Collins.

(With Plate I.)

Cataract at the anterior pole of the lens results from a degeneration and breaking up of lens fibres in that position, together with proliferation of the overlying intracapsular epithelium.* It most commonly forms in cases of perforating ulcer of the cornea, but may in infants' eyes follow ulceration of the cornea without perforation.

* *Vide* paper on the "Minute Anatomy of Pyramidal Cataract," 'Trans. Ophth. Soc.,' vol. xii, p. 89.

Two views have been put forward as to the way in which ulceration of the cornea excites changes at the anterior pole of the lens. Hulke suggested that it was due to contact of the lens and cornea arresting the osmose of nutritional fluid through the anterior capsule. He pointed out that in an infant's eye the anterior chamber is so exceedingly shallow that the swollen condition of an inflamed cornea might be quite sufficient to bring them into contact apart from any perforation.

Hutchinson's view was that the close proximity of the inflamed area in the cornea to the anterior pole of the lens could, by "a kind of vital catalysis," excite changes in it. He objected to Hulke's theory on the ground that there was a proliferation of cells which he thought inconsistent with an arrest of nutrition.

To meet this objection I have demonstrated* that besides the proliferation of capsule cells there is some degeneration of lens fibres, and that the probable course of events is—1st, arrest of osmose of nutritional fluid by contact of lens and cornea; 2nd, shrinking and degeneration of lens fibres with some softening of lens capsule, and consequent decrease of the tension within the capsule in the affected locality; 3rd, proliferation of the capsule cells where the tension within the capsule is decreased.

It has since occurred to me, that evidence in favour of one or other of these theories might be obtained by finding out if contact of a sarcomatous growth with the lens capsule, in the part lined by cells, excited similar changes.

For this purpose I looked through the sections of a series of cases of sarcoma of the iris and ciliary body. In most cases of sarcoma of the ciliary body where the growth touches the lens it does so at the posterior and lateral part. I have, however, met with one specimen of melanotic sarcoma involving the anterior part of the ciliary body and iris, in which the tumour pressed on the antero-lateral part of the lens. Where the two are in

* 'Researches into the Anatomy and Pathology of the Eye,' 1896, p. 14.

contact the superficial lens fibres have undergone degeneration, and overlying the degenerated area the intra-capsular epithelial cells have proliferated, forming a patch of laminated tissue similar to that met with in anterior polar cataracts (Plate I, fig. 1). That contact of an intra-ocular growth with the lens capsule may excite proliferation of the intra-capsular epithelium had not escaped the notice of that acute observer, Otto Becker, who refers to it in his monumental work on the lens.

This fact, then, observed by Otto Becker, of which I have been able to bring before you a typical example this evening, favours strongly the theory that anterior polar cataract is due to an arrest in osmose of nutritional fluid through the capsule, for in the case of contact with a sarcoma, it is obvious, there can be no question of vital catalysis from some neighbouring inflammatory process.

In early fœtal life, before the secretion of the aqueous humour has commenced, the lens receives nutriment from a network of blood-vessels which surround it, forming the fibro-vascular sheath; the anterior part of this sheath lies between the lens and the back of the cornea. On the opening out of the anterior chamber by the secretion of the aqueous humour the lens becomes separated from the back of the cornea, and the fibro-vascular sheath disappears.

Should the opening up of the anterior chamber for some reason be delayed until after the disappearance of the fibro-vascular sheath, then in the region where the lens and cornea remained in contact the nutrition of the former would be affected, and changes would be expected to occur similar to those produced by contact of lens and cornea from ulceration.

I have already demonstrated to this Society * a congenital anterior polar cataract occurring in association with congenital aniridia, which presented precisely the same microscopical appearances as the anterior polar cataracts produced after birth by ulceration of the cornea.

I have to-night to show you the drawing of the micro-

* 'Trans. Ophth. Soc.,' vol. xiii, p. 128.

PLATE I.

Mr. E. Treacher Collins' paper on the Pathogenesis of Anterior Polar Cataract (p. 124).

FIG. 1.—Melanotic sarcoma of the ciliary body, pressing on the side of the lens, and causing there a subcapsular patch (o) similar in appearance to an anterior polar cataract.

FIG. 2.—Section of a congenitally malformed lens. It is much flatter from before backwards, and has a dense anterior polar opacity.

FIG. 3.—Section of a lens with an anterior polar cataract of eleven years' formation. Patch of degenerate lens substance (o) deeper than mass at anterior pole, which probably gave rise to a second opacity.

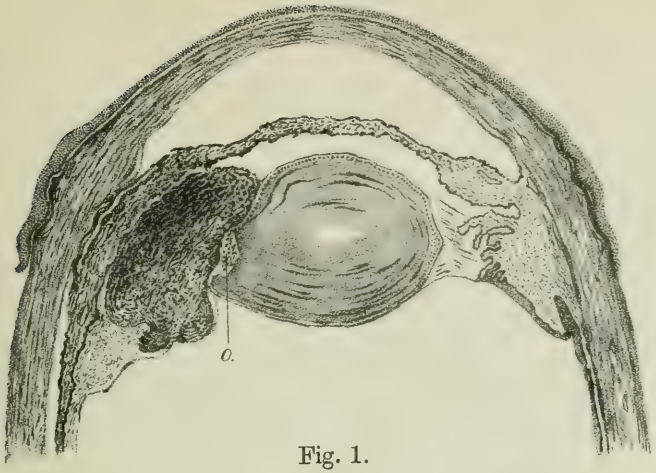

Fig. 1.

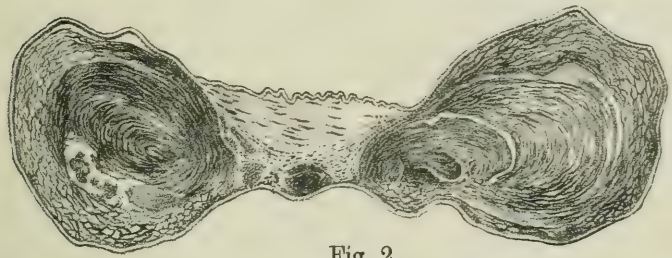

Fig. 2.

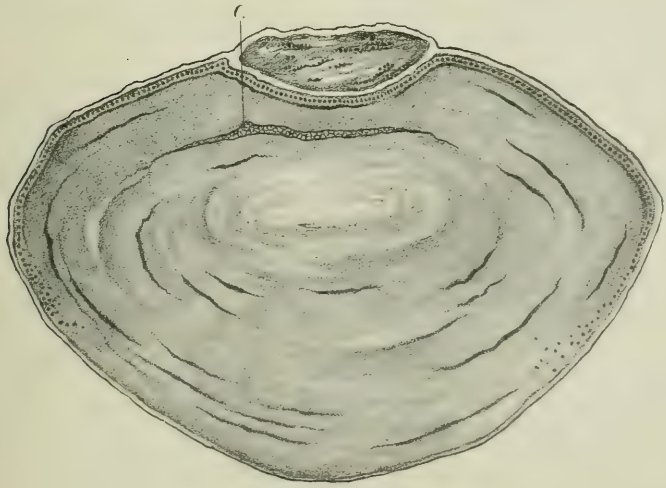

Fig. 3.

Colhoun, del. Bale, Sons & Danielsson, Ltd., Lith.

scopical appearances of another congenital anterior polar cataract, which occurred in an eye having congenital buphthalmos and anterior synechia of the iris (Plate I, fig. 2).

It is a matter of common clinical experience that in performing the operation of discission in some cases of congenital cataract the lens is found not to present its normal dimensions, but to appear shrunken or flattened antero-posteriorly. In the centre of some of these apparently flattened cataracts a more or less raised, dense white, central nodule is observed. This drawing represents the section of a cataract which I believe, had it been possible to examine it during life, would have presented such an appearance. In the centre, immediately behind the much-wrinkled anterior capsule, is a large laminated mass, such as is produced by proliferation of the capsule cells in anterior polar cataracts. Beneath this large, conical, laminated mass are signs of extensive degeneration of the lens fibres. So extensive has this degeneration been that the lens is much flattened from before backwards, and the anterior polar laminated mass extends backwards in the centre as far as the posterior capsule.

In a former communication to this Society I mentioned that cases of anterior polar cataract are occasionally met with in which, at a little depth in the lens substance, a second opacity is seen.

In some lectures I gave at the College of Surgeons I was able to quote three cases illustrative of this condition, in all of which several years had elapsed between the inflammatory attack, which was presumably the initial cause of the anterior polar opacity, and the time the patient came under observation.

I have suggested that the explanation of the two opacities is to be found in the increase in the size of the lens, the new formation of cortical lens fibres which occurs separating the mass at the anterior pole, formed by the proliferated cells, from the degenerated lens substance underlying it.

Since then I have met with four more cases presenting a similar appearance ; of these I append brief notes.

Case 1.—Sophia B—, æt. 48, attended at the Moorfields Hospital on April 30th, 1896. She stated that her mother had told her that she had had inflammation of her eyes when a baby, and that there had been specks on them ever since. In the right eye there was a white opacity at the anterior pole of the lens, and behind it, a little depth in the lens, a second opacity, separated from the first one by some clear lens substance.

In the left eye there were two similar opacities in the lens, but they were not completely separated by clear lens substance, a thin opaque band still uniting them.

Both corneæ were clear.

V. { R. $\frac{6}{60}$ Hm. 4 $\frac{6}{12}$ partly + 5 J. 1.
{ L. $\frac{6}{60}$ Hm. 4 $\frac{6}{12}$ partly + 5 J. 1.

Case 2.—William B—, æt. 10, came to the Belgrave Children's Hospital on August 24th, 1897. His mother stated that his eyes were inflamed in infancy, and discharged a great deal.

A faint nebula was seen in the centre of each cornea, and there was a small white dot-like opacity at the anterior pole of each lens. In the right eye there was a second opacity in the lens, in a line with the one at the anterior pole, and separated from it by some clear lens substance.

In the left eye there was a faint mark, in the same position as the deeper opacity in the right lens, hardly itself sufficient to be described as an opacity. V. in each eye = $\frac{6}{36}$ unimproved.

Case 3.—Henry Richard D—, æt. 60, came to the Moorfields Hospital on December 19th, 1897. He stated that his eyes were inflamed in infancy, and that his sight had always been defective. There were nebulæ of both corneæ.

In the right lens there was a dense white opacity at the anterior pole, which was bifurcated at its margins.

In the left lens there were two dense white circular opacities at the anterior pole, one deeper than the other; they seemed to be united in the centre. There was also a faint grey haze deeper than the deepest white patch. V. in each eye: $\frac{6}{0}$ $\bar{c}$ − 15 $\frac{6}{60}$.

Case 4.—Richard L—, æt. 44, came to the Moorfields Hospital on December 13th, 1897. He stated that his eyes were inflamed when he was eighteen months old, that his sight had always been defective, and that the left eye was operated on in 1880. There were nebulæ in both corneæ. In the right eye there was a dense white opacity at the anterior pole of the lens, and behind it, separated by some clear lens substance, was a second faint grey opacity. In the left eye there was a coloboma of the iris down and in; a dense white opacity at the anterior pole of the lens, but no second deeper opacity. V. of R. = $\frac{6}{60}$, of L. = counting fingers.

In all these four cases, as in those previously referred to, an interval of several years had elapsed between the inflammatory attack and the time the patient came under observation.

In the left eye of Case 1 and in both eyes of Case 3, the separation of the deeper from the superficial opacity was incomplete. In the left eye of Case 1 a thin band remained connecting them. In the right eye of Case 3 it cannot be said that there are two opacities, the edge only showing bifurcation. Seeing that the formation of a second opacity in the lens in connection with anterior polar cataract is not very uncommon, it occurred to me that if I looked through my collection of sections of lenses with anterior polar cataracts, possibly I might meet with one showing changes situated a little depth in the lens likely to give rise to a second opacity. This I have succeeded in doing. The case is one of which the details have already been published in the 'Transactions' of this Society, vol. xii, pp. 99—101. In it, eleven years had elapsed between the formation of the anterior polar

opacity and the time at which the eye was removed. At the anterior pole of the lens immediately beneath the hyaline capsule is a mass of nearly homogeneous but faintly laminated material, which has patches of epithelial cells embedded in it (Plate I, fig. 3). This mass is slightly raised above the level of the rest of the lens, and the lens substance is slightly cupped beneath it. A thin complete layer of hyaline capsule, lined by epithelial cells continuous with those lining the capsule elsewhere, separates the mass at the anterior pole from the lens substance beneath it. The lens fibres immediately underlying the anterior polar mass appear normal, but a little depth in there is an area over which they have become broken up into irregular amorphous granules and detritus. This area corresponds fairly accurately in shape to that of the mass at the anterior pole, and I think there can be no doubt that they were at one time in contact, having become separated by the gradual growth of new lens fibres inwards between them.

(*June 9th*, 1898.)

V. DISEASES OF THE RETINA AND CHOROID.

1. *A case of pseudo-glioma due to choroido-retinitis, which was secondary to a meningitis probably caused by otitis media suppurativa.*

By L. Vernon Cargill.

The case which I am about to relate is one of that variety of pseudo-glioma in which there is an inflammatory exudation into the vitreous due to purulent choroido-retinitis. The interest of the case depends upon the fact that the affection of the eye was secondary to meningitis, which, in its turn, in all probability arose from suppurative disease of the middle ear.

W. L—, æt. 5 months, was admitted into the Royal Eye Hospital, Southwark, January 2nd, 1893. The father and mother and one other child, æt. five years, were quite healthy. Both children had been born at full term, and there had been no miscarriages. There was no history of phthisis, and there was no sign or history of specific disease. The mother stated that a fortnight before confinement she had knocked herself with some force in the epigastrium against the back of a chair. The child had received no injury since birth, and had been in perfect health until three months old (*i. e.* two months before admission), when one evening it was suddenly taken with convulsions and a "screaming fit," and according to the mother's statement "screamed for four hours right off." For forty-eight hours after this it suffered from constantly recurring fits, passing out of one

into another, and there was frequent vomiting. The temperature ranged over 102° F., and the medical man who was called in diagnosed meningitis. About a fortnight later "the left eye became bloodshot and looked peculiar." Meanwhile the child, from being bright and lively, became dull and quiet. It did not take nourishment; it frequently vomited; its bowels were irregular, constipation alternating with diarrhœa; and it progressively wasted.

On admission the infant was emaciated, with retracted and enlarged head, in which the anterior and posterior fontanelles, and the coronary, sagittal, and lambdoid sutures were very marked. Its dull stuporose condition was occasionally broken by fits of fretfulness and irritability, especially so when it was disturbed. The heart-sounds were normal, but the heart was acting feebly. The lungs were normal. There was great tendency to vomiting, and a troublesome rectal prolapse. There was no retraction of the abdomen. The temperature was about normal (98·8° F.). The edges of the right optic disc were slightly blurred, and the disc looked congested, but otherwise that eye was normal. The left eye was injected, there being general conjunctival injection as well as ciliary injection. The tension was — 2. The cornea was clear and bright. The anterior chamber was shallowed centrally by a pushing forwards of the pupillary portion of the iris against the back of the cornea; whilst around the periphery the anterior chamber was deeper, the base of the iris being drawn back. The pupil was irregular, semi-dilated, and inactive to light. The iris was so atrophied that light could be shone through it in parts on oblique focal illumination. The lens was clear. There was a dull yellowish-white reflex seen through the pupil, which had attracted the mother's attention. There was no red reflex from any part of the fundus, and the yellowish-white opacity seemed to fill in the whole of the back of the eye, but no blood-vessels could be distinguished upon its surface. On examining the ears the

right membrana tympani was found to be intact; but the left was perforated, and there was some material like inspissated pus in the left auditory meatus. On questioning the mother closely about a discharge from the ears she recollected there having been some slight thick discharge from the left, which she did not take much notice of.

The infant was treated with mercurial inunction and grey powder without much good effect. The circumference of the head on January 31st, 1893, was $17\frac{1}{2}$ inches; on February 22nd, 1893, $17\frac{3}{4}$ inches; and on March 20th, 1893, 18 inches. The temperature during these months was subnormal. In May, 1893, there was an offensive thick greenish-yellow discharge from the left ear, and it lasted for about a fortnight. The hydrocephalic bulging and head retraction gradually increased, the fits of fretfulness and irritability gave place to a condition of continuous stupor, and emaciation became extreme. The left eye shrunk more and more, whilst the right remained unaffected, except for the development of a pale optic disc. The child died on September 9th, 1893, *i. e.* just about ten months after the first onset of illness. Unfortunately for the complete and satisfactory proof of the probable sequence of events which this case suggests, no post-mortem examination was obtained.

In the 'Royal London Ophthalmic Hospital Reports,' vol. xiii, there is an article by Treacher Collins on pseudo-glioma. In it he refers to two cases of the class of pseudo-glioma under consideration, in which the meningitis to which it was secondary was probably started by purulent disease of the middle ear. In one case reported in his article ('Roy. Lond. Ophth. Hosp. Rep.,' vol. xiii, p. 387, Case 13) an abscess in the tympanum was only discovered when some inspissated material was removed by syringing a week after the patient had been under observation. In the other case, reported by Nettleship ('Ophth. Soc. Trans.,' vol. v, p. 101), the ear disease was only discovered at the post-mortem examination. Collins

shows from these two cases that an examination of the ears themselves should always be made in this variety of pseudo-glioma, and the inquiry not be confined to the statements of the patient's mother. It was this caution that led me to examine the ears in this case; and, as I have narrated, it was only on close questioning after the examination that the mother called to mind some slight discharge. In Mr. Collins's case the abscess was in the left tympanum, and the right eye was affected with pseudo-glioma. In Mr. Nettleship's case the right ear and left eye were involved. In both this case and Nettleship's there was papillitis in the fellow-eye. It would seem, as Knies suggests, that when the living agents of inflammation enter the optic nerve and its sheaths a purulent process ensues; whereas when the chemical products only enter neuritis alone develops. In Collins's case, quoted above, the purulent process was demonstrated to have developed by direct extension from the meninges. Hofman has also published a case ('Neurol. Centralb.,' 1886, p. 357) in which direct purulent extension from meningitis along the optic nerve was demonstrated. In a discussion on a paper by Dr. J. Walter Carr, read before the Royal Medical and Chirurgical Society last April (1897), entitled "Non-tuberculous Posterior Basic Meningitis in Infants," Dr. Barlow insisted on catarrh as a cause, and he thought otitis media played some part in the production of the disease. Otitis media was very common in infants, and the course of events was, he thought, somewhat as follows:—Virulent microbes in the mouth might spread up the short Eustachian tube of infants, and find a ready nidus in the inflammatory exudation there, and then be easily transmitted to the meninges. It was significant that the disease was commoner in the first two years of life, when otitis media was frequent, and, though it was difficult to prove, he suggested that infective catarrhs were a cause of the disease. Mr. Ballance also believed in the catarrhal origin of the disease, and pointed out that in very young

children the tympanic cavity might contain pus without there being any bulging or congestion of the membrane. Taking into account the ill-developed condition of the temporal bone, the open state of the sutures, and the free lymphatic and venous connections between the tympanum and inside of the skull, it was easy to understand how infection might take place.

The case which I have related is of the same clinical type as those under discussion at the Royal Medical and Chirurgical Society,—a previously healthy infant, under one year ; early and constant cervical opisthotonos, persisting to the last ; stupor or coma of long duration ; a chronic course, and no evidence of congenital syphilis or tuberculosis. The variety of pseudo-glioma with which we are dealing may, then, in this type of case, originate primarily in an infective catarrh.

With regard to the treatment of these cases of meningitis, early incision of the membrana tympani offers the best chance of recovery, and of course also the best preventive of a pseudo-glioma due to such a cause. Mercurial treatment has been followed by satisfactory results, and should be tried in addition. Mr. Ballance also recommends that trephining should be done early, so as to relieve tension and prevent the spread of septic processes. If it is done when there is marked hydrocephalus it is impossible to limit the escape of fluid, and the skull will rapidly collapse, and convulsions set in.

In the case which I have narrated the membrana tympani was already perforated, the septic processes had extended to the eye, and hydrocephalus was rapidly developing. Mercurial treatment was tried, but it was too late to expect any result.

(*November* 11*th*, 1897.)

Mr. Treacher Collins said Mr. Cargill's case was very interesting, as affording additional evidence of the occasional connection between pseudo-glioma and middle ear disease. He would like to mention, as he had pointed

out before, that these cases more often began as a retinitis than a uveitis. Very frequently, in his pathological examinations of eyes affected in this way, he had found that the choroid was not at all involved, though there had been an extensive inflammation of the retina. It could be easily understood that when there was a plastic retinitis effusion would be thrown out into the vitreous chamber, and there give rise to the shining white reflex which was the prominent symptom in these cases. Very often such cases were preceded by a history of some acute specific fever, and he thought it very probable that the connection with the specific fever occurred in the following way:—With, for example, an attack of scarlet fever there was often an inflammation in the throat, the inflammation in the throat might spread up the Eustachian tube and cause middle ear disease. The middle ear disease might give rise to basal meningitis, and the inflammation in the meninges might spread down the optic nerve to the eye, giving rise to neuro-retinitis and the symptoms of pseudo-glioma.

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2. *"Pseudo-glioma" in both eyes.*

By Ernest Clarke.

The special interest of the case lies in the fact that a brother and sister have attended Moorfields suffering from the same disease.

Hilda A—, æt. 10 months, was first seen by me eight months ago at the Central London Ophthalmic Hospital, the mother bringing her because she said the child "did not seem to notice anything."

There was no history of injury or "fits," and the child seemed in good health. Both pupils were dilated with atropine, and the following notes made:

Right eye.—A greyish mass seen at the posterior pole of the lens, moving with the lens. By direct illumination this opacity is seen to be almost circular, and the red reflex of the fundus is seen all round its periphery. Behind this there are several mobile black masses in the vitreous, and on the temporal side and below a large mobile detachment of the retina is conspicuous.

Left eye.—Both indirect and direct examination reveal a large, irregular, mobile, opaque mass in the vitreous. On the temporal side is a whitish, flocculent-looking mass, which is probably a retinal detachment.

The child was put on Potass. Iodid., and the changes since observed are that the conditions above noted in the right eye are less marked; and in the left eye, while the mass in the vitreous has diminished, that on the temporal side has become more visible, and projects more forward.

The mother says that the child is in perfect health, and she thinks is beginning to see a little.

Family history.—Father operated on when eight years old, at Northampton, for "cataract;" three operations and no successful result. Seen in 1893 by Mr. Tweedy at Moorfields, letter headed "Acute Conjs. R. Cataract, L. Rotatory Nyst."

Father and mother are first cousins. No history of syphilis.

The mother has had no miscarriages; has had six children as under:

1. Reginald.—Admitted into Moorfields when fifteen months old in June, 1887. There was a white reflex from behind the lens in the right eye, and the anterior chamber was very shallow. The eye was excised, and pathological examination revealed extensive retinal detachment and opaque lymph on the posterior capsule and on the retina. The choroid and retina were abnormally adherent in parts; some small hæmorrhages were present (see paper on "Pseudo-glioma" by Treacher Collins, 'Ophthalmic Hospital Reports,' vol. xiii, part 3, p. 381). Child died three and a half years later from diphtheria.

2. Sidney.—Well.

3. Leonard.—Well.

4. Clara.—Attended Moorfields in January, 1892, when four months old. Had been feverish when two months old, but had no fits. Had always been very irritable, screaming a great deal, especially at night. Examination revealed in both eyes a yellow reflex behind the lens; the anterior chamber was shallow, and the periphery of the iris retracted. Left pupil smaller than right. Seen two years later and a careful examination made by Mr. Donald Gunn, to whom I am indebted for the following notes:—"The child has never attempted to walk, is pale and flabby, and does not appear to use the right hand much. Is lethargic and irritable, says nothing but 'mama.' No obvious rickets, no knee-jerks. No p. l. in left eye, and probably none in right. R. E.: Surface haze of cornea. Anterior chamber shallow. Iris structureless. A yellowish-white reflex seen behind lens. Tension normal. L. E.: Cornea clear, anterior chamber very shallow. Pupil smaller than right, and blocked by mass of yellow lymph." This child is now in her seventh year and is only just beginning to walk, and is quite blind.

5. Sybil.—Well.

6. Hilda.—Child shown to-night.

(*December 9th*, 1897.)

The PRESIDENT asked whether there was any suspicion of the cases being of a tubercular nature. It was exceedingly rare for so many cases of pseudo-glioma to occur in one family. It would be interesting to hear from Mr. Clarke why one child could not walk.

3. *Pseudo-glioma.*

By W. C. Rockliffe, M.D.

John W—, æt. 12 weeks. The mother had noticed something wrong with the right eye when six weeks old. There was no history of fits, injury, or inflammation.

Family history.—Father died young, phthisis. Mother, her relatives, and all six children except the patient, strong, healthy, and perfect vision.

L. E.—Apparently normal.

R. E.—Cornea healthy, Acc. n. Complete synechiæ, T. – ?

A yellowish-white mass to be seen behind the pupil, with one or two small vessels on its surface. Diagnosis, glioma, ? pseudo-glioma.

As the mother stated, the child was "fretful and irritable."

The eye excised December 10th, 1897; forwarded in formol to Mr. C. Devereux Marshall, who kindly mounted the specimen and reported:

"Cornea clear, anterior chamber deep, pupil small. Iris retracted at its angle, which is closed. Some posterior synechiæ present. Lens distorted and pressed out of shape. Vitreous absent. Retina detached from optic disc to ora serrata. Subretinal space entirely filled with blood-clot and coagulated albuminous material. No glioma present. Choroid *in situ*, but is thin, and shows signs of old inflammatory changes.

(*Card specimen. May 5th*, 1898.)

4. *Case of albuminuric retinitis in a child aged twelve years.*

By Arnold Lawson and George A. Sutherland, M.D.

Florence B—, æt. 12 years, was brought to the hospital on October 29th, 1897, suffering from headache and vomiting. Examination showed the presence of albumen in the urine and albuminuric retinitis in both eyes.

On inquiry it was elicited that shortly before last Christmas the patient was seized somewhat suddenly with headache and vomiting, and for three days was confined to bed. Previous to that time her health had been very good, and since then she had never been quite well. The headaches had continued at intervals, and recently had occurred about every second day. They were worse in the morning, and were frequently accompanied by vomiting, and always with great prostration. At other times she was a bright, active child. The mother had never noticed any swelling of the legs, but the child had spent four months at Eastbourne in the summer, and it was reported that the legs were much swollen there for a short time. She passed water freely and often, both during the night and the day. No impairment of vision had been observed, the child being able to read or sew with ease. The bowels were rather constipated. Her home diet had been plain, consisting largely of vegetables. She was always a ravenous eater, and was especially partial to meat. There had appeared to be some loss of flesh during the previous few months.

She had had measles and whooping-cough when quite young, and more recently two attacks of pleurisy, affecting the right side. She had never had scarlet fever or any cardiac affection. When she was two years old her brother had scarlet fever, but there was no suspicion of her having been infected.

There were six other children in the family, all of

whom were healthy. One other child had died of pneumonia. The mother suffered from chronic rheumatism, and phthisis was present in her family. There was no history of Bright's disease.

On admission she was well nourished but undersized, and not anæmic or pigmented. There was no drowsiness or lethargy, but, on the contrary, the patient was extremely bright and intelligent.

There was a diffused heaving impulse over the præcordial region. The apex-beat was felt three quarters of an inch outside the nipple line in the fifth intercostal space. The first sound of the heart at the apex was rough and followed by a short blowing murmur, and the second sound was accentuated. At the base the sounds were clear and ringing, the second being accentuated. Arterial pulsation was visible in the large vessels of the neck.

The pulse was small, regular, 80 per minute, of high tension, and there appeared to be some thickening of the vessel wall.

The urine was acid, sp. gr. 1010, cloudy, with a slight deposit. Albumen was present in considerable amount, and also a trace of pus. Microscopical examination showed pus cells, squamous epithelial cells, a few triple phosphates and tube-casts. The casts were not numerous, but were present in considerable variety, large and small, straight and convoluted, hyaline for the most part, but also a few epithelial, granular, and fatty ones. There was a slight amount of œdema in the lower extremities.

The condition of eyes.—Ophthalmoscopically the fundus of each eye presents the features of albuminuric retinitis, the fundus changes being more advanced and typical in the left. On both sides there is a marked optic neuritis with tortuous and congested veins, the arteries being unaffected in size. The right disc is surrounded at a short distance from the margin by a halo of silvery white spots, more conspicuous in some places than in others.

The retina in the neighbourhood of the *right* papilla is

pale and in many places hazy through exudation, which conceals the vessels. The silvery spots extend outwards in irregular splashes to the macula, which is apparently uninvolved. In the left fundus there is a typical silver-white stellate figure on the inner side of the macula, with its apex at the macula. The latter by contrast looks very dark, and is stippled with white dots. As in the right fundus there is a partial halo of small white spots about the disc; the retina is pale, and on the inner side of the disc it is very hazy from exudation. Two minute hæmorrhages are visible along the branches of the upper temporal vein.

R. V. $= \frac{6}{6}$, L. V. $= \frac{6}{60}$.

It is worth remarking that the child has never at any time complained of her eyes, and was quite unaware of anything being the matter with them.

Progress.—After ten days in hospital there is little change to report. The patient's general health has continued good. Vomiting has occurred twice in the afternoon after food. Headache has not been complained of. The cardiac condition shows little alteration, but the murmur is not constantly present. The amount of urine is from 25 to 30 ounces per diem, and only once has been as much as 40 ounces.

Albumen is constantly present, but varies from a mere trace to 3 per cent. There is no special frequency of micturition. The treatment has been milk diet, barley water, Mistura Alba, and one grain of calomel on alternate nights.

As regards the condition of the eyes, they have become rather worse. Fresh patches of effusion have been discovered, and some fresh white spots have appeared. In addition a well-marked stellate figure is now in process of formation in the right eye, the vessels converging to the macula on the inner side being severally picked out by a white streak.

This would appear to be a case of primary chronic interstitial nephritis occurring at an unusually early age. The symptoms are very similar to those met with in a

typical case of that affection in later years, and the occurrence of well-marked albuminuric retinitis at the age of twelve must be regarded as very exceptional.

In an exhaustive paper on chronic interstitial nephritis in childhood * Dr. Leonard Guthrie says, "Albuminuric retinitis might be expected to occur in children as in adults suffering from chronic interstitial nephritis; but it is not mentioned in any of the cases collected, and in my own patients I have never discovered it."

Professor Heubner, in a very recent work on nephritis in childhood, does not refer to the occurrence of albuminuric retinitis.

The ætiology of these cases is usually very obscure, and the present example is no exception to the rule. It is possible that a long course of over-feeding may have so affected the blood as to induce irritative and inflammatory changes in the kidneys.

I can find no recorded case of albuminuric retinitis occurring at such an early age as twelve years.

Mr. Benson † in 1883 recorded a case of albuminuric retinitis in a boy æt. fifteen years. The urine, sp. gr. 1015, contained much albumen with granular and hyaline casts. No mention is made of this lad's history or condition as regards heart, blood-vessels, lungs, &c., except that he ate very well and was in perfect health.

Mr. Jabez Hogg ‡ in 1873 reported another case occurring in a lad of eighteen. The patient died in hospital, and at the autopsy typical granular kidneys were found, with a very large hypertrophied heart. There was no alteration of the arterial walls. In this case the kidney disease was brought on by prolonged exposure to cold and wet as a bill poster, the lad being also a very heavy drinker.

Mr. Jonathan Hutchinson § reported a case of albumi-

* The 'Lancet,' 1897, vol. i.

† 'Trans. Acad. Med. Ireland,' 1883.

‡ The 'Lancet,' 1873, vol. ii.

§ 'Brit. Med. Journ.,' 1871, vol. i.

nuric retinitis and albuminuria in a girl whose age is not mentioned. In this case no cause for renal mischief could be ascertained, and Mr. Hutchinson suggested that it was a case of nephritis after an aborted attack of scarlatina.

The fact that albuminuric retinitis only occurs in a small percentage of adults who suffer from chronic interstitial nephritis sufficiently explains its extreme rarity in youth, when chronic interstitial nephritis must be itself a very rare disease.

Wagner ('Virchow's Archiv,' Bd. xii) found only 10 cases of albuminuric retinitis in 157 cases of chronic nephritis.

Frerichs ('Die Brightische Nierenkrankheit') found 6 cases in 41 cases of chronic Bright's disease.

Wadsworth ('Boston City Hosp. Rep.') found 12 cases in 90 unselected cases of chronic Bright's disease.

Though the vast majority of these cases die within two years of the onset of retinal disturbances, the average duration of life appears to be considerably modified by efficient treatment and good circumstances. This is well shown in the statistics of 72 cases of albuminuric retinitis published by Dr. Possaner of Zurich in 1895, all of which were followed to their termination. She inferred that the retinitis was discovered soon after its occurrence.

Thirty-nine cases were private patients of good circumstances, whilst 33 were hospital patients who might be said to be in good circumstances only as long as they were inmates of a hospital. With regard to the 39 private patients, 23 cases died within two years, 16 cases lived from two years to eleven years; whilst of the 33 hospital patients, 29, including all the male patients, died within two years, and only 4 cases, all being women, lived from two to six years.*

(*November* 11*th*, 1897.)

* The authors will communicate a further report of this case during the next session of the Society.

Mr. Nettleship said he had seen one case of albuminuric retinitis in a young boy. He could not put his hand on the notes, so was uncertain of the age ; but he was below puberty, and was under Dr. Sharkey's care at St. Thomas's Hospital some years ago. Dr. Sharkey and he saw the boy twice at an interval of twelve months, and in that time the condition of the retina improved very much. He thought he was right in saying it was in all respects a typical case. He had also seen a case in a little girl which, in some respects, was very much like Mr. Arnold Lawson's case ; she was very undergrown, and had obviously had some form of retinitis. The eyes had partially recovered, leaving a certain amount of damage, both ophthalmoscopically and to the sight. It seemed likely that the case was one of albuminuric retinitis. About a year before he saw her she had been seriously ill, suffering from what the family doctor called Bright's disease, and he was informed that during that illness, or shortly afterwards, her sight got very bad ; but she recovered gradually, and her sight improved, although it did not become so good as it had been before the illness. When she was brought to Moorfields there was a very evident partial atrophy, or at least pallor of the optic discs, and some retinal changes quite consistent with past albuminuric retinitis. She still had albumen in the urine. She was seen at intervals for several years ; her eyes remained in exactly the same condition, but she grew and improved greatly in health and strength.

Mr. Holmes Spicer said he had seen a case last August under the care of Dr. Ridge Jones at the Victoria Hospital. The patient was a boy æt. 10 ; he showed all the signs of acute nephritis. No cause for the attack was found ; the patient had never had scarlet fever. The urine contained albumen, blood, and granular and hyaline casts ; there was œdema of the legs and lower eyelids, and there had been an attack of uræmic coma.

On examining the fundus there were a small number of fine hæmorrhages in the nerve-fibre layer of the retina ;

there were no other changes. Arterial tension was not markedly raised. The patient made a good recovery.

Dr. Breuer said that Mr. Lawson mentioned he had not heard of a case of albuminuric retinitis in a patient younger than twelve years. Mr. Bull published a series of 103 cases of albuminuric retinitis, the youngest patient being æt. 5 years. Post-mortems had only been made in a few of these cases, but in all of them the affection was interstitial nephritis, none of them showing the nephritis which occurred in scarlatina.

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5. *Secondary syphilis; extensive intra-ocular hæmorrhage in right, retinitis with hæmorrhages and development of new vessels in left.*

By J. B. Lawford.

Thos. K—, æt. 30, shop assistant; first seen about April, 1896. Primary syphilitic sore in August, 1895, followed by red papular rash, falling of hair, and sore throat. He was under treatment at home for some time, and symptoms disappeared. Again under treatment at home, by mercury and iodide of potassium, from May 14th, 1896, till July 4th, 1896, at which date he was admitted to St. Thomas's Hospital. His history then was that five weeks previously he had noticed floating spots before both eyes. Three weeks later he found that right was very defective, and thinks there has been no change since.

On admission (July 4th, 1896).—R. V. = hand movements at 6 feet; objects appear to him as if very far off. T.n.; iris slightly discoloured; vitreous by focal light shows a reddish, hazy anterior part. Lens clear. No fundus reflex. L. V. = $\frac{6}{6}$ Hm. 1·75 D.; J. 1. In extreme periphery of retina, especially up and in, some small streaky hæmorrhages, and here and there a small spot of yellowish exudation. A vein passing up and in shows several sharp

curves, as if retina were swollen and folded at this part. No physical signs of disease in thorax or abdomen. Urine 1014; no albumen, no sugar. Mercury administered by inunction; patient kept in bed.

July 9th.—A candle flame appears red when looked at with right eye. Reddish blood-clot distinctly visible in front part of vitreous.

21st.—Right: a faint red reflex from fundus at upper and lower periphery. Left: hæmorrhages in retina fading.

August 24th, 1896.—R. V. = hand movements. Very faint red reflex at periphery. Blood-clot in vitreous still visible. L.: numerous minute vitreous opacities, obscuring view of fundus very slightly. Fundus generally looks healthy, but there are still several hæmorrhages in the retina, chiefly in one group situated above and to temporal side of y. s. V. under atropine $\frac{6}{18}$ partly, + 1·75 D. $\frac{6}{9}$ partly.

Discharged from hospital; to continue under treatment as an out-patient.

Patient has continued under observation, and has had regular treatment. Up to February 11th, 1897, he was taking mercury (Hyd. $\bar{c}$ Cret.), and since that date has taken iodide of potassium.

February 11th, 1897.—Right: still much blood-clot in vitreous; no fundus reflex except at extreme periphery.

Left: two minute pale hæmorrhages in retina up and out, and several small circular spots of choroidal atrophy. A small bunch of new tortuous vessels on surface of optic disc, near its upper edge (seen for the first time).

July 8th, 1897.—R. V. = $\frac{6}{18}$. Dull red reflex, no details of fundus; numerous large floating opacities in vitreous. L. V. = $\frac{6}{9}$ and J. 1. The new vessels have increased in extent and project forwards.

October 14th, 1897.—No material alteration.

November 11th, 1897.—R. V. = $\frac{6}{18}$. L. V. = $\frac{6}{9}$ partly.

In left there are two groups of small tortuous new vessels attached to O. D., near its upper and lower margins.

They project forwards into vitreous, but are closely coiled, and no free branches can be made out.

In vol. iv of the Society's 'Transactions' are two very good illustrations of this condition, from a patient under Mr. Nettleship's care. That patient was the subject of syphilis.

(*Card specimen. January 27th,* 1898.)

P.S.—June, 1898.— $\begin{cases} \text{R. V.} = \frac{6}{9} \text{ partly; J. 1 barely.} \\ \text{L. V.} = \frac{6}{6}\text{; J. 1.} \end{cases}$

Patent is still under treatment. The bunches of new vessels are perhaps smaller.

The Chairman said he had seen two or three such cases, and they seemed to generally present a syphilitic history.

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6. *Embolism of the central artery of the retina with hæmorrhages at and about the macula; mitral stenosis.*

By Arnold Lawson.

About three weeks ago patient, a rather stout woman æt. 42, stooped to pick something up off the floor of her bedroom. Within a few minutes she noticed that there was a partial film over her sight, and brushing her hand across her eyes to try and clear it away she discovered that the right eye was quite blind.

R. V.—No p. l. The ophthalmoscopical picture is typical of embolism of the central artery. There is an obvious cherry-red spot with pale œdematous retina and pale disc, and thread-like arteries on the disc itself. Whilst many of the arterial branches continue their course from the disc, represented by minute red threads or white streaks, one or two branches become suddenly dilated after passing the disc edge, and regain

a normal size. This is marked in the case of the superior and inferior nasal arteries, and in the case of the latter the dilation is so sudden as to present the appearance of a shoulder to the artery. The arterial branches that have thus re-dilated continue of a normal size to the periphery. No cilio-retinal vessels can be made out. At the macula the uniform redness is interrupted by stippling of a white punctiform character, and one or two cholesterin crystals can be seen. Slightly below and to the outer side of the macula a few small irregular capillary hæmorrhages are apparent. They occur along the line of a few arterioles, and present the appearance of red currants on a stalk.

Patient has a forcible pre-systolic thrill, and a loud rough pre-systolic murmur at the cardiac apex.

(*Card specimen. January 27th,* 1898.)

The Chairman said it was very unusual for the artery to suddenly get so full at a little distance from the disc; one did not see where the blood was supplied from. He thought there must be some communication with the cilio-retinal vessels.

Mr. Lawson said he wished to point out the rapid dilatation which had taken place in some of the arteries after passing over the optic disc, in which situation they remained thread-like. Some of the arteries had almost a shoulder to them; and the question of collateral circulation seemed very curious. Apparently there were no cilio-retinal vessels present. The case also showed hæmorrhages at the macula, which were infrequent though not very rare. In this case the condition was apparently due to diseased vessels. The patient had very extensive heart disease, a loud pre-systolic murmur, and a marked thrill, and she probably had some mitral regurgitation as well.

7. *Retinitis proliferans.*

By J. Herbert Fisher.

W. R—, male æt. 21, sent to me at St. Thomas's Hospital on January 18th, 1897. Two years before he noticed one morning he could not see plainly. He tested the eyes, and found the sight of the R. was almost entirely lost, and of the L. somewhat obscured. The loss of vision of the R. he attributed to a blow from a nut. A month later he went to St. Bartholomew's, and was an in-patient three weeks; he detected no improvement till a month after leaving, when the L. cleared and remained good till a month before I saw him, when he found he could no longer see to read the newspaper or do his work as a shoemaker. Under Mr. Power at St. Bartholomew's the case was entered as one of hæmorrhagic retinitis. R. V. = $\frac{1}{5\,0}$, L. V. = $\frac{5}{7\cdot5}$. It was noted that in R. he had extensive hæmorrhage into vitreous, and hæmorrhagic retinitis in L., and that he had been training for a flat race previous to the failure. When I first saw him in January, 1897, he was unable to count fingers with the R. L. V. = $\frac{6}{1\,2}$.

Right.—In whole lower half of fundus were to be seen arborescent strands of glistening connective tissue over surface of retina, and coming forwards into the vitreous; this tissue nourished by many fresh-formed vessels, apparently in continuity with the retinal circulation. The focus of change appeared to be near the site of O. D., which was obscured. In other parts of fundus were patches of disturbed retinal pigment, and there were some spots of hæmorrhage in the upper part of the retina.

Left showed two spots of recent hæmorrhage at the O. D., and coming forwards from here into vitreous was a strand of what I considered to be lowly organised connective tissue, with blood in its meshes; no vessels made

out. There was no evidence of congenital syphilis or acquired venereal disease, and the family history had no bearing on the case; no gout or rheumatism. The urine was normal. I treated him as an in-patient with complete rest and biniodide of mercury. There was no history of constipation.

The condition varied only as to the amount of hæmorrhage; many recent spots appeared at intervals. At the end of February, 1897, the L. failed suddenly to $\frac{1\cdot5}{60}$ and J. 19, the R. having improved to $\frac{6}{60}$ and J. 16. Ophthalmoscopic examination revealed a great deal of blood in vitreous of L.; details could not be seen for it.

In May and June the vitreous of L. again cleared till V. became $\frac{6}{12}$ and J. 1, and has since remained so, all hæmorrhage having now disappeared. In October, 1897, a definite vessel was noted in connection with the connective tissue of L. for the first time.

To-day, March 10th, 1898, my note is—

R. V. = $\frac{6}{60}$,
L. V. = $\frac{6}{9}$, $\frac{6}{6}$ 2 letters } under homatr. and cocaine.

Right.—No hæmorrhage seen. Position of O. D. obscured by connective tissue, which extends from there into vitreous in three main arms, down and out, down and in, and a smaller one upwards, which seems to end in tissue of lower organisation. Two wavy vessels of dark colour accompany the first two limbs, and seem to be for the most part on a plane anterior to them; the anterior extremities of these vessels can be seen with + 8·0 D. to + 10·0 D., and each ends in a bunch of fine twigs. No hæmorrhages seen.

Left.—No hæmorrhages. Bands of white, glistening connective tissue in upper outer and upper inner periphery, both with adventitious vessels. A fan-shaped piece of connective tissue covers the upper sector and margin of O. D.; this also is vascularised. In extreme outer periphery is a small piece of well-formed shining tissue, also with vessels of new formation; and in lower fundus

are some white spots of pigmented change apparently in the retina.

T. n. in each.

(*Card specimen. March 10th*, 1898.)

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8. *Proliferating retinitis in middle age associated with glycosuria.*

By J. Herbert Fisher.

E. L. S—, male æt. 48, coach builder, sent to me at St. Thomas's Hospital in October, 1896, complaining of mist in front of R. eye of three months' duration. He *considered the L. perfect, and I have allowed him to continue to do so.*

At this time R. showed, running almost vertically through centre of O. D., the sharp crescentic edge of a connective-tissue formation; tissue is white, fibrous-looking, and glistening, and hides many large retinal vessels, as well as the inner half of O. D. It appears to be in the vitreous, and to be nourished by loops of very fine vessels, presumably offsets of retinal vessels, but not traceable to a parent trunk; the tissue fades off imperceptibly towards nasal side of fundus; many large retinal hæmorrhages are dotted over the fundus, and not limited to the area of new-formed tissue.

Left eye showed many retinal hæmorrhages of varying sizes, and I thought a small vascular loop projected into vitreous from nasal side of O. D. Patient gave no history of serious illness; always accustomed to heavy work. No venereal history or rheumatism. One brother said to suffer from gout. Not subject to epistaxis.

At his next visit, in November, 1896—

V. of R. $\frac{6}{60}$, $-0{\cdot}75$ D. $= \frac{6}{36}$.

V. of L. $\frac{6}{6}$, very fairly.

Urine 1016, acid, pale, a trace of albumen to cold nitric acid and boiling tests; reduces Fehling's solution, but rather reluctantly.

On December 9th V. of R. improved to $\frac{6}{18}$. There were fewer hæmorrhages, and the whole picture of fundus was clearer and more easily seen. Was being treated with Potass. Iodid.

On February 24th, 1897, the R. O. D. seemed to me entirely obscured by the connective tissue. The amount of hæmorrhages in either fundus varied considerably. In March R. had V. $\bar{c} - 2{\cdot}0$ D $\frac{6}{18}$.

In April, 1897, I considered the connective tissue in R. had materially increased; there were several recent hæmorrhages; one branch of vessels came forwards into vitreous as much as 9·0 D.

In July a few striæ in L. lens were observed. V. of R. only $\frac{4}{60}$, L. $\frac{6}{6}$.

Urine, sp. gr. 1032, acid, a definite trace of albumen; it reduces Fehling's solution abundantly without boiling, but requires prolonged warming to do so.

Pulse not of high tension. No œdema of legs. No diabetic symptoms of any kind. Salicylate was prescribed.

After taking the new drug in September, 1897, the specimen obtained scarcely gave the sugar reaction.

My last note is in December, 1897.

R.—Fundus clear; still the white glistening tissue; two main strands of vessels come forward into the vitreous, and many white dots are to be seen on a plane posterior to the vessels. His statements show that he sees better with the temporal half of his retina.

L.—Some spots of retinal hæmorrhage are scattered over the peripheral parts of fundus.

Urine, sp. gr. 1020; a trace of albumen; sugar by the fermentation test, 6 grs. ad ℥j.

(*Card specimen. March 10th*, 1898.)

9. *A case of retinitis proliferans in which the eye was examined after death.*

By Percy Flemming.

(With Plates II and III.)

The term *retinitis proliferans* was originally given by Manz (1) to certain cases observed by him with the ophthalmoscope, and was not based upon a histological examination of the eyeball. In consequence it is impossible to give an exact definition of the disease, and I have called the case which I am about to describe "retinitis proliferans" because I feel convinced, from a careful study of the specimen, that it belongs to the same group of cases recorded under that name by Manz and others, although it does not accord in some respects with the clinical picture usually associated with the term. The subject has not previously received much attention by the Society, and this, coupled with the fact that the specimen certainly shows a very uncommon condition, has induced me to take up some of the time of the meeting to-night.

I propose briefly to relate the case, next to describe the naked-eye and microscopic appearance of the specimen, and suggest an explanation of the conditions present, and finally review the case in the light of others previously published.

The patient was a man 22 years of age, under the care of Dr. Rose Bradford, in University College Hospital, in the summer of 1897. On admission he stated that his sight had been failing since the previous Christmas, and had completely disappeared from the right eye since July. The patient presented all the features of chronic renal disease, the pulse being high tensioned, the urine containing one half to one fourth albumen. No signs or history of syphilis.

I examined his eyes on August 18th, and made the following note :

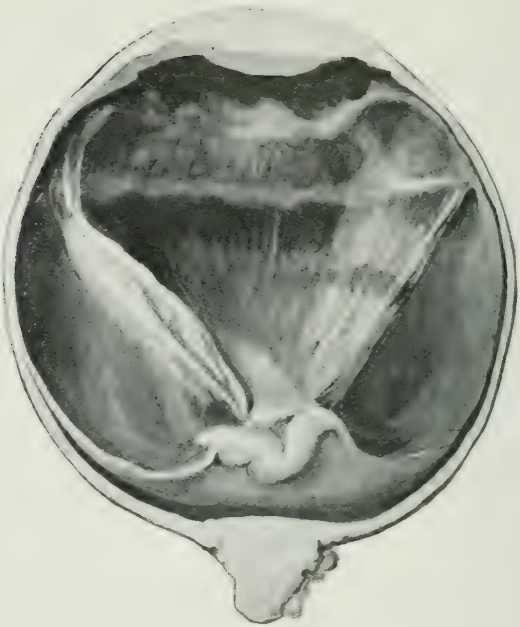

FIG. 1.

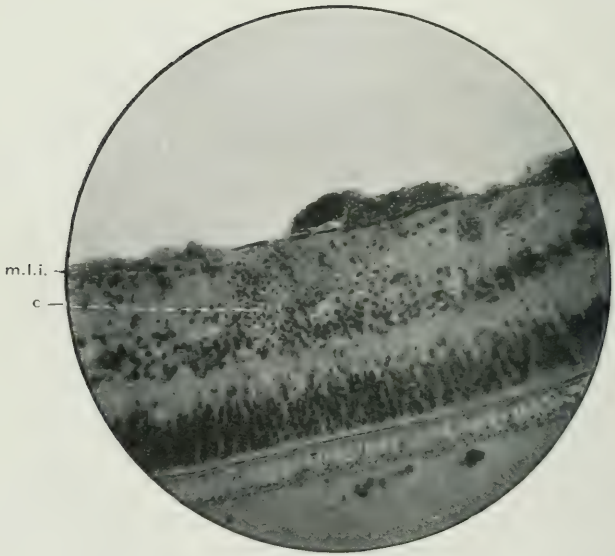

FIG. 2.

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PLATE II.

Mr. Percy Flemming's paper on a Case of Retinitis Proliferans (p. 154).

Fig. 1.—Lower half of right globe.

Fig. 2.—Section of retina showing a hæmorrhage (c) in its superficial layers and blood-corpuscles adhering to inner surface, *i.e.* in front of the interna (*m. l. i.*). From photomicrograph.

"*Right eye.*—There is an extensive vitreous hæmorrhage obscuring all details of fundus; at the site of the disc is a white mass projecting forwards, and from it superiorly white bands can be traced peripherally. No vessels are to be made out on the white bands. Tension normal.

"*Left eye.*—Media clear; disc presents the characters of subsiding neuritis. There are numerous hæmorrhages in the superficial and deeper layers of the retina. No signs of albuminuric retinitis."

The patient rapidly became worse, and died with uræmic symptoms on September 12th, having had a severe attack of epistaxis three days previously.

Post-mortem examination revealed small, tough, granular kidneys. The right globe and the posterior section of the left were removed and hardened in formol. Sections of the left retina showed a swollen disc with connective-tissue formation, and the arteries rather thickened. No increase in thickness of the retina. The lower half of the right globe was mounted in glycerine jelly, and sections were cut of the upper half and examined microscopically.

Description of lower half of right lobe (Pl. II, fig. 1).—Posteriorly over an area 15·5 mm. across, the retina is detached; the middle third of the detached portion presents a dense white appearance, is folded, and has a thickness of 1·8 mm. The space between the choroid and retina has a maximum depth of 3 mm., and is occupied by coagulated subretinal fluid. Laterally and running from behind forwards are three sharp ridge-like projections of the retina. The cavity of the eyeball is divided into two compartments, a central funnel-shaped one and a peripheral one, separated by a thin membrane attached posteriorly to the middle of the detached retina for a distance of 3·2 mm., spreading out anteriorly to be attached to the ora serrata, and having its greatest thickness at its posterior attachment. The central cavity contains vitreous, and at one spot there is a little flaky lymph

attached to the ciliary processes. The outer cavity is occupied in part by a large blood-clot which is in contact with the outer surface of the membrane, extending nearly to the ora serrata, its anterior end having a distinctly serrated appearance, but only in apposition with the retina at the angle between the latter and the membrane posteriorly. The lens is not in place. The angle of the anterior chamber is open. The sclerotic and choroid seem normal.

The *upper half of the globe* showed a membrane attached anteriorly near the ora serrata for the greater part of its circumference, and ending freely posteriorly about midway between iris and the detached retina; the space between the latter and the membrane was occupied by a large clot. The retina was thickened and folded, and presented ridges similar to those in the other half.

Microscopic examination.—Optic nerve appeared normal posterior to the lamina cribrosa; at this point there is distinct cell infiltration. The central vessels are normal. Papilla much swollen and projects forwards; the swelling mainly consists of spindle-shaped nucleated cells with a few round cells; no vessels are to be seen. The retina on either side of the papilla (corresponding to the detached portion) is thickened and much folded (some of the apparent thickness being due to the folding), and presents much alteration in structure. The rods and cones are wanting; the outer molecular zone is increased in width, and the fine Müller's fibres seem more numerous and distinct than natural. The layers internal to the inner nuclear layer are much disorganised. There is an increase of fibres running perpendicularly and ending freely, the membrana limitans being absent here. (The folded condition of the retina makes it more than usually difficult to cut sections perpendicular to the surface, but the above description is based upon the comparison of many sections, and with special reference to the possibility of the section being oblique.) This thickened part gradually subsides into the normally attached retina, the several

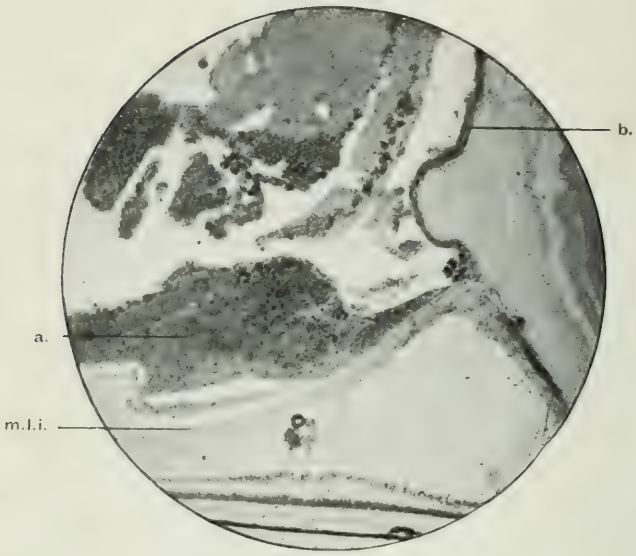

FIG. 1.

FIG. 2.

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PLATE III.

Mr. Percy Flemming's paper on a Case of Retinitis Proliferans (p. 154).

FIG. 1.—Section near ora serrata.

m. l. i. Membrana limitans interna.

a. Blood-clot becoming organised.

b. New membrane attached to retina. From photomicrograph.

FIG. 2.—Section through retina posteriorly.

b. New membrane.

c. Thickened and folded retina. From photomicrograph.

layers become recognisable, and the membrana limitans reappears. In places hæmorrhages are seen in the nerve-fibre layer, and some sections show such a hæmorrhage rupturing the interna and a layer of blood-corpuscles adhering to the inner surface of the retina (Pl. II, fig. 2). The vessels are not very numerous, and where present do not show any thickening. Other hæmorrhages are present in the deeper layers, and near the optic disc are large cyst-like spaces filled with colloid material. A section through one of the ridges shows that the retina is simply detached; all its layers are to be recognised and appear normal.

In the region of the ora serrata (Pl. III, fig. 1) important changes are observed. At a point corresponding to the attachment of the membrane, Müller's fibres—normally more prominent here—appear drawn out, elongated, and broken, and give rise to a triangular projection, the apex being directed inwards. The hinder side of this projection is continuous with the membrana limitans interna. Springing from the apex of the projection is the delicate membrane consisting of distinct nucleated fusiform cells, two or three deep. Deeper sections through the same region show extensive hæmorrhage into the spaces formed by the pulled-out and broken Müller's fibres, and a direct continuity can be traced between the membrane and the fibrous tissue of the retina. In one section a new blood-vessel with endothelial walls is seen applied to the posterior side of the projection (immediately internal to the membrana limitans interna), and to enter the base of the membrane. In the angle between the hinder side of the projection and the retina is a large collection of red corpuscles. In some sections the corpuscles only are to be distinguished; in others there are numerous large well-stained cells intermingled with them, whilst in others the corpuscles merge into well-defined connective-tissue membranes with large lacunar spaces,—in all cases the new membranes being on the side of the clot nearest to the retina. The lacunar spaces are not lined by cells, and do not appear to be blood-vessels.

Unfortunately the half of the globe reserved for microscopical purposes did not allow of many sections being cut through the attachment of the membrane and retina posteriorly. In some (Pl. III, fig. 2) the membrane consisting of the similar fusiform cells is seen applied to the retina, in others there is a tongue-shaped projection forward, the base of which is clearly continuous with the retinal fibre layer, and in another such a projection shows at its base either a small hæmorrhage or a new vessel. The retina at the ora serrata only presents the above characters at the place of origin of the attached membrane (*i. e.* the membrane attached also to the posterior pole), and the appearances suggest that the membrane has contracted, and in doing so has dragged upon and pulled out Müller's fibres on the one hand, and on the other has dragged the retina from the choroid. Sections of the ora serrata region elsewhere have a fairly normal appearance, and although there is no definitely organised membrane, yet there is a large collection of blood-corpuscles (apparently limited in front by the hyaloid) in contact with it.

There are distinct evidences of inflammation of the iris base and ciliary body. In some sections the angle of the anterior chamber is open, in others the root of the iris is applied to the cornea.

The choroid and sclerotic are normal.

The chief interest attaches, I think, to the thin membrane stretching from front to back. From its attachments it seems clear that it must in some way be related to the hyaloid, but its definite structure shows that at any rate it is something more than hyaloid. From the character of the cells composing it, from its relation to the blood-clot at its anterior attachment, and its connection with the retina posteriorly, I take it to be a new formation.

In the 'Ophthalmic Hospital Reports,' 1896, is a valuable paper by Mr. Herbert Fisher (2), giving the details of the microscopical examination of an eyeball in which a typical subhyaloid hæmorrhage had been observed a month pre-

viously. The figures accompanying the paper show a hæmorrhage in the inner (anterior) layer of the retina, breaking through its substance and being limited for the most part by two membranes, the inner (anterior) of which is structureless, and seems evidently to be hyaloid. The outer (which in places is in contact with the inner) is composed of cells with definite nuclei. This membrane seems to resemble, in structure and relations, the membrane in my specimen. Mr. Fisher regarded it as the stripped up membrana limitans interna. This seems to me an impossible view to take. In the first place, the membrana limitans interna is not a membrane in the sense that it can be stripped off, the apparent membrane is really formed by the apposition of the ends of Müller's fibres, as can be easily shown by silver preparations; and in the next place, the nucleated character of the membrane is inconsistent with the idea of it being the limitans. It seems to me that the nucleated membrane in Mr. Fisher's case must be a new formation, and the figure gives one the impression that organising processes are going on in the clot. I have gone into this case because I think it marks a stage in the process which has given rise to the appearances found in my specimen.

Repeated hæmorrhages are a feature in the clinical records of cases of retinitis proliferans, and in the present case—the patient suffering from Bright's disease—such recurrences are very likely. It seems fair to suppose that a retinal hæmorrhage occurred, which (as seen in some of the sections) ruptured the interna and spread itself out as a thin layer between this and the hyaloid, as in Mr. Fisher's case, but rather more extensively. Owing to the inflammatory process present at the time in the retina and papilla this clot became organised, meaning by that that new tissue elements derived from the retina grew into the clot. Some of the sections afford, I think, clear indications of this. This new tissue would be more or less completely incorporated with the hyaloid, but anteriorly near the ora serrata a separation exists for a short distance. In

this way the hyaloid would become thickened and strengthened. If at this stage another and more extensive hæmorrhage took place, it might strip up the thickened hyaloid and give rise to the appearances shown in the specimen. I think this must have been the sequence of events, for it is difficult to imagine such an extensive hæmorrhage as is present in the specimen being resisted by a normal hyaloid.

The membrane in contracting caused in front a pulling out of Müller's fibres, and behind a detachment of the retina.

The appearance of the other membranous formations with their lacunar spaces recalls the ophthalmoscopic picture given by Manz in his first article.

Although many clinical cases have been recorded, I had only been able to find accounts of three histological examinations until I had an opportunity of reading the 'Transactions of the American Ophthalmological Society' for 1897, which have only recently arrived in this country. In that volume is a paper by Weekes containing the report of two further cases, only one of which was microscoped. Manz in all has published five cases; in one of these the eye was enucleated and examined (1). In it there was a complete funnel-shaped detachment of retina, with signs of cyclitis and obliteration of the angle of the anterior chamber. On the inner surface of the retina was a delicate membrane composed of imbricated cells with a distinct nucleus, attached and continuous with the retina posteriorly. This membrane was placed immediately outside (posterior to) the hyaloid membrane; blood-corpuscles were in places adherent to it. In some places the hyaloid was separated from the retina, and there the cells were found adherent both to the latter and the hyaloid. He regarded the cells as in part endothelial. The retina was thickened, showing increase in Müller's fibres, especially in the nerve-fibre layer. In many respects this case resembles my own, the main

difference being that in mine the membrane is separated from the retina by the blood-clot.

In Weeks' (3) case the vitreous chamber was almost completely filled with blood, on removing which several membranes were seen. One "is attached to the retina near the ora serrata, and forms a loose, almost complete diaphragm just anterior to the equatorial plane of the globe." Another "takes origin from near the optic nerve, spreads out and reaches to the equator of the globe." The new-formed membranes are in part composed of young connective-tissue cells, spindle-shaped formative cells, and in their older portions connective-tissue formation is complete. The vessels were thickened, the anterior layers of the retina showed fibrous degenerative changes, the ganglion-cells had largely disappeared. A fibrous process projected forwards into the vitreous from the optic nerve, made up mainly of prolongations from the connective tissue of the disc. The membrana limitans was apparently absent over this projection and at the neighbouring part of the retina. This is by far the most complete record I have been able to find; it resembles my own case in many particulars, notably in the arrangement of the diaphragm-like membrane attached to the ora serrata, and in the structure of the thickened retina. Weeks' second case is very scantily reported, and resembled apparently Manz's.

Denig (4) describes but does not figure a case having several points in common with mine. Müller's fibres were hypertrophied, the inner nuclear layer distorted, and the nerve-fibre layer had disappeared. The new formation consisted of spindle-cells, and was partly in contact with hyaloid and partly adjoined the coagula. The fifth specimen examined belonged to a different group of cases, namely, those in which after an injury resulting in vitreous hæmorrhage new connective-tissue formation occurs. Banholzer (5) reports the case, the eye being enucleated eight months after the injury. The retina was much thickened and ridged; a white band

surrounded the disc whence other bands extended forwards. From one of these a thin membrane stretches into the vitreous. Müller's fibres were hypertrophied, and their inner ends split; there was also formation of new fibres. There were marked signs of cyclitis (cyclitic membrane, &c.).

Numerous clinical cases have been recorded. De Wecker (6) and Leber (7) have insisted more particularly that hæmorrhage is the essential factor in these cases, and describe the gradual formation of membranes as observed ophthalmoscopically.

Schultze (8) reports some cases, and in commenting upon them objects very much to Manz's term retinitis proliferans. Schultze himself regards a retinal hæmorrhage as the primary factor of the condition. This causes destruction of the retinal elements with hypertrophy of Müller's fibres, the unabsorbed blood-fibrin becoming converted into fibrous tissue. But he does not explain how this conversion is brought about.

Martinet (9) and Probsting (10) record cases of retinitis proliferans occurring in the subjects of Bright's disease, and the latter author later (10) was able to produce a certain amount of retinal proliferation by the experimental injection of blood into the vitreous of rabbits.

Loring (11), while allowing that hæmorrhages into the substance or upon the surface of the retina may finally produce membranous formations, yet thinks that ophthalmoscopically such membranes have a different appearance from those arising from definite retinal proliferation.

A careful review of all the published cases leaves no doubt in my own mind that the case I have described belongs to the group of cases recognised ophthalmoscopically as retinitis proliferans. The presence of the large subhyaloid hæmorrhage behind the membrane alone prevented the latter being recognised during life.

As to the *pathology* of the condition, there can be no doubt that hæmorrhage from the retina or into the vitreous is an important factor in the production of new

membranes, and most writers agree in regarding this as the only factor, in contradistinction to those who regard the appearances as essentially due to a retinitis. In some cases hæmorrhages have been observed to occur from the new membranes. It seems clear to me that there must be some factor other than mere hæmorrhage to explain why it is that the clot in these particular cases becomes organised, and why an excess of fibrous tissue is found in the retina. It seems that this second factor must be of the nature of an inflammatory process, such as has been described under the name plastic retinitis, affecting mainly the sustentacular tissue of the retina. The co-existence of such a retinitis and hæmorrhage might well account for the transformation of the latter into connective tissue. What is the causative agent of such a retinitis seems part of the larger question of the ætiology of sclerosis of the nervous system in general. For the sustentacular tissue of the retina is embryologically and morphologically identical with the neuroglia, and indeed in the cerebellum the resemblance is so close that the cone-shaped ends of the neuroglia fibres make by their apposition a membrana limitans as in the retina.

The most probable view seems that sclerosis is due to some toxic agent, or possibly several; and although the case I have related does not throw much light upon this point, yet the fact that the patient died from chronic renal disease at an early age makes it at least likely that such a toxic condition may have been present. And Gull and Sutton showed long ago that in chronic Bright's disease there was an extensive overgrowth of neuroglia of the nerve-centres. In this connection, too, may be noted the frequency of a history of diabetes, syphilis, and albuminuria in those rare cases of new vessel formation in the vitreous which clearly have some analogy to the cases under consideration. Finally, the frequency with which retinitis proliferans occurs in both eyes points to some general cause being present, though of course the

latter might merely act in the way of producing hæmorrhage.

References.

1. Manz.—(i) 'Graefe's Archiv,' vol. xxii, part 3, p. 229 (figure); (ii) 'Graefe's Archiv,' vol. xxvi, part 2, p. 55 (specimen); (iii) 'Zehender's klin. Monat.,' 1890, p. 63 (figures).
2. Fisher.—'Roy. Lond. Ophth. Hosp. Reports,' vol. xiv, part 2, p. 292.
3. Weeks.—'Trans. American Ophth. Soc.,' vol. viii, part 1, p. 158 (figures).
4. Denig.—'Knapp's Archives,' vol. xxvi, p. 585.
5. Banholzer.—'Archiv f. Augenh.,' vol. xxv, p. 186 (figure).
6. De Wecker.—'Traité Complet,' vol. ii, p. 557.
7. Leber.—'Graefe Saemisch,' vol. v, p. 665.
8. Schultze.—'Arch. f. Augenh.,' vol. xxv, p. 298 (figure).
9. Martinet.—'Deut. med. Woch.,' 1891, No. 9.
10. Probsting.—(i) 'Zehender's klin. Monat.,' 1890, p. 73; (ii) 'Graefe's Archiv,' vol. xxxviii, p. 140 (figure).
11. Loring.—'Text-book of Ophthalmoscopy,' vol. i, p. 178 (figure from Strawbridge); vol. ii, p. 166 (figures from Manz and Leber.)

Other cases.

Jaeger's Hand Atlas, fig. 87.
Goldzeiher.—'Klin. Monat. f. Augenh.,' xvii, p. 45.
Simon.—'Centr. f. Augenh.,' November, 1896, p. 321.
Strawbridge.—'Trans. American Ophth. Soc.,' ii, p. 304.

(*June 9th*, 1898.)

10. *Cystic degeneration of retina.*

By W. C. Rockliffe, M.D.

Case 1.—Walter S—, æt. 12, accidentally discovered his left eye was blind October 30th, 1897. There was no history of fits, injury, or inflammation, but apparently short-sight all his life.

The family history was good, and all his relatives had perfect vision.

R. V. $\frac{6}{60}$, no improvement with glasses; reads J. 1 at 6″. Iris grey-blue, T. — ?, slight conjunctivitis, projection bad, considerable floating opacities in vitreous.

L. V. Hand movement at 3′; T. —, slight conjunctivitis; A. C. shallow; iris green, rolled on itself; lens opaque, fundus invisible. Ordered Syr. Ferri Iodidi (to be watched).

January 24th, 1898.—R. V. same, but patient and parents insist that the vision is much worse. L. V. Hand movement at 16″; more injection of eyeball; A. C. almost *nil;* iris more rolled on itself; lens more swollen or prominent; T. — 2.

February 11th.—R. V. $\frac{6}{60}$ with great difficulty, reads J. 1 badly; increased conjunctivitis and lacrymation, and some intolerance of light.

12th.—Left eye excised and forwarded to Mr. C. D. Marshall, who kindly mounted specimen and reported:

"T. — 2; cornea clear; A. C. normal. Fair reflex through pupil; angle of A. C. open. Lens *in situ* partially opaque. Vitreous much shrunken and blood-stained. Retina completely detached from the optic disc to the ora serrata, and in it numerous cysts are developed. The choroid is *in situ.*

"*Microscopically.*—The cornea, angle of A. C., and iris are all normal. The lens is somewhat vacuolated, and at its periphery opaque. The retina is detached, and contains a large number of cystic dilatations, which vary in size

from those which are purely microscopic to others which are quite visible to the naked eye. The dilatations seem to be situated between various layers of the retina, and between no two layers in particular. The opaque lens shows no change; the cause of this was doubtless some inflammatory affection."

March 29th.—R. V. improved; $\frac{6}{36}$, reads J. 1 easily; lacrymation, conjunctivitis, and photophobia gone.

The specimen shows three or more cystic dilatations protruding beneath detached retina, one of which (the central and larger) appears to touch if not to be adherent to the choroid.

Case 2.—Miss A—, æt. 32, single, consulted me October 18th, 1897, *re* right internal strabismus, which she stated had been gradually increasing with defective vision eight or nine years.

L. V. $\frac{6}{18}$, not improved with glasses; reads J. 2 $\bar{c}$ + 2 D. Pupil n. T. n. Field of vision full. Fundus normal.

R. V. Hand movement 18″ in parts of field only; best in centre and to outer side. Pupil semi-dilated. T. n.

Retinoscopy (under atropine).—L. E. +2·5. R. E. +4·5.

Examination of fundus showed three large globular detachments, and several smaller scattered throughout, more especially outwards and downwards, also several pigmentary deposits in the choroid near the y. s. Lens clear.

There was no history of injury or previous inflammation, but as she insisted that her left vision was rapidly deteriorating the eye was excised October 27th, and the specimen forwarded in formol to Mr. C. Devereux Marshall, who kindly mounted the same and reported:

"Cornea clear; A. C. very deep; angle open. Lens thin and *in situ;* pupil dilated. Retina detached over nearly its entire extent. Situated in it are two cysts rather larger than peas; these extend as far forwards as the ora serrata. They are adherent to the choroid at two white atrophied spots which mark their situation. These

spots are 3 mm. in diameter. There are some streaks of pigmented choroiditis seen, and along one of these the retina and choroid are adherent.

"*Microscopically.*—Cornea healthy, and angle of A. C. open. Iris and ciliary body healthy. Situated in the retina are numerous cystic spaces, which vary considerably in size; they are between the inner and outer nuclear layers, the inner molecular layer being hardly visible between them. At certain places the retina and choroid are adherent by inflammatory attachments, and both membranes show inflammatory changes. The cause of this trouble was primarily a choroido-retinitis."

December 12th.—L. V. considerably improved, viz. $\frac{6}{12}$, reads J. 1 easily without glasses.

The specimen shows two large cystic growths about the size of a pea bulging into the subretinal space, one of which is distinctly adherent to the atrophied choroid.

(*Card specimen. May 5th,* 1898.)

Mr. Marshall said it was impossible to say what was the position of the cyst; this was chiefly due to a degenerate state of the retina, in which there was a good deal of inflammatory exudation. He did not quite agree as to the extreme rarity of such cases, although it was uncommon to find such well-developed cysts as were present in Dr. Rockliffe's cases.

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11. *Retinitis circinata.*

By E. C. Fischer.

(With Plate IV.)

Mrs. B—, æt. 66, attended the Royal London Ophthalmic Hospital, Moorfields, as an out-patient under the care of Mr. Lang in April of this year, because she could not obtain suitable glasses elsewhere. Until this time she was unaware of the defect of vision in her left eye.

She has always enjoyed fair health. During the last two years, however, she has suffered from aching pains in the loins, and for the last twelve months has been passing a large quantity of clear urine. At the age of thirty-five the sight of both eyes became very bad, so that she was unable to read large print; this condition, however, passed off in about three months. The eyes were not examined at that time.

On admission, R. V. $\frac{6}{6}$, Hm. 3·0; L. V. fingers at 12 inches. Urine, sp. gr. 1020, acid reaction, no albumen, no sugar. Heart-sounds normal.

Ophthalmoscopically, R. fundus quite healthy. No hæmorrhages. L. fundus shows almost a complete wreath of white exudation surrounding the macula. The broadest portion of the wreath comes close up to the optic disc, and appears very slightly raised at this point. At the lower part of the ring, where the exudation is less dense, the ring is completed by a large number of minute white spots. Just below this, and rather to the nasal side, is a recent horizontal band of hæmorrhage. The margins of the wreath have a peculiar white finely dotted appearance, while at other parts it appears as though brushed out. In all positions the retinal vessels are seen crossing the white ring. The macular region itself does not present the dark grey changes usually observed in this condition; there is, however, definite pigmentary disturbance at this spot. There is a considerable accumulation of pigment within the ring margin, especially on the temporal side of the macula. No other hæmorrhages can be observed in other parts of the fundus, but there are numerous minute red dots on various portions of the white wreath (Pl. IV).

This case forms one of a group now well known clinically, although until recently the pathological nature of the condition has been doubtful. Fuchs (von Graefe's 'Archives,' vol. xxxix, 3, p. 229) was the first to collect and describe a series of twelve cases of this nature. In his opinion the ophthalmoscopic appearance was due to a

PLATE IV.

Drawing of the fundus of the left eye of E. C. Fischer's case of Retinitis Circinata (p. 167).

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fibrinous exudation into the deeper layers of the retina. De Wecker ('Archiv d'Ophth.,' 1894), however, was in favour of a hæmorrhagic origin of the white plates, and it is certainly the case that hæmorrhages are usually to be found either in the affected or non-affected eye. At a meeting of this Society Mr. Holmes Spicer ('Transactions,' 1894, p. 133) exhibited a case of retinitis circinata. In the non-affected eye of his patient were to be found numerous small hæmorrhages, but no white deposits; while in the affected eye were numerous white deposits, but no hæmorrhages. In Mr. Lawford's case ('Transactions,' 1896) hæmorrhages were observed in the non-affected eye, while in Mr. Law's and Mr. Hartridge's cases ('Transactions,' 1896) the changes were symmetrical but showed no hæmorrhages. All these cases would, therefore, point to the white appearance being due to an earlier stage of hæmorrhage.

It was not, however, until quite recently that Dr. Amman of Zürich (Knapp's 'Archives,' March, 1898, p. 203) was enabled to make a pathological examination of this condition. His patient had been under observation for a long period of time, and the eye had presented the typical appearance of retinitis circinata. It must, however, here be noted that on more than one examination of the urine albumen was found to be present. This is not usually the case,—in fact, the contrary holds, for in only one of all the above recorded cases was albuminuria found to be present; this occurred in one of Fuchs's cases.

In his investigation Dr. Amman found numerous clots lying in the intergranular layer of the retina, with numerous transitions between extravasations of blood and hyaline plates; in fact, he could trace gradual transition stages between hyaline plates and hæmorrhages. Some of the white plates were quite homogeneous, others were finely granular, and others coarsely granular, the last more closely resembling red blood-corpuscles. In certain of the plates were to be found large distended cells which stained black with osmic acid; the size and

number of these cells increased towards the periphery of the patch, and where they were very numerous the hyaline substance had almost disappeared. It was entirely to these clusters of fat cells that Dr. Amman found the white patches were due, and the white patches appeared where hæmorrhages had previously existed.

(*Card specimen. May 5th*, 1898.)

Mr. Lawford said Mr. Fischer's case differed from the few which had come under his own observation in two respects: first, in that the macular region was free from any definite evidence of hæmorrhage, such as was, he thought, usual in these cases. In all the cases he had seen before, and in all the pictures that he could remember, there had been evidence of macular change, probably the result of hæmorrhage. Secondly, in this case he thought he was right in saying that the band of exudation at the inner part was very definitely raised above the rest of the fundus. There were one or two vessels running over it near the disc, the level of which could be estimated, and which were at a higher level than the rest of the fundus. Another point was that in this patient the other eye was apparently quite free from any retinal disease; while in the other cases he had seen the second eye, although less affected, had always shown a certain amount of retinal disease.

Mr. Hartridge said he showed a case about two years ago, a rather doubtful case, in which the circle was much less marked than here, but there was characteristic pigmentation and disturbance of the macula. In the other eye there was pigmentary disturbance of the macula without any ring. There was no sugar or albumen in the urine. The case, with a picture, was published in the 'Transactions' for 1896. The chief interest about the case was that the white patches had now entirely disappeared, leaving simply a pigmentary disturbance of the macula.

Mr. Marcus Gunn, in answer to the President's invitation, said he had only seen a few such cases. From the general condition of the changes he had formed the opinion that retinitis circinata was simply one of the manifestations of an old-standing œdema, thus marking out the periphery of the affected area, the size of the circle varying according to the amount of the previous affection. It was thus a peculiar form of the same process that more familiarly caused a radiating puckering, *e. g.* the asterisk of so-called "renal retinitis." In the one case the œdema extended from the fovea centralis, but if there was a focus of inflammation in the retina, especially near the yellow spot, and consequent swelling of the surrounding area, the œdema extended *circularly* for a certain distance, and where the œdematous area stopped it came in contact with a healthy part of the retina. It was at this peripheral circular fold or puckering that the changes took place, and hence the shape. Such an explanation was, of course, purely theoretical.

Mr. Doyne said Mr. Gunn's remarks did not tally with his own ideas. He thought the changes were simply due to decolourised blood; in this case, certainly, on the margin of the patch there was a distinct hæmorrhage. The whole aspect and colour of these cases resembled those of so-called diabetic and traumatic retinitis, where there had been considerable effusion of blood. If it were necessary to have an explanation of why it did not occur in the central area, it might be that the functional activity there caused the blood to be absorbed. It was so in the present case. He was prepared to suggest that the white areas in diabetic retinitis were due to decolourised blood.

12. *Intra-ocular tubercular growth.*

By J. Tatham Thompson.

Male æt. 15.

Clinical features.—Acute iritis, followed ten days later by the development of a tumour in the ciliary region, believed to be by the doctor in charge of the case an abscess,—"a gathering under the conjunctiva," as he expressed it. Dr. Wilson of Haverfordwest lanced it, and says that pus escaped. V.: R. E. $\frac{20}{40}$, J. 1; L. E. p. l.

The patient suffered much pain, and when I first saw him there was a large pinkish-white growth at the sclero-corneal junction above and slightly to the nasal side. It was about the size of a shilling, and its height about a quarter of an inch. Iris muddy, and a trace of hyphæma. Believing it to be a sarcoma I excised the eye; in doing so the globe burst near the apex of the tumour, and partially collapsed.

Report on the tumour (by John Griffith).—The eyeball was divided through the prominence of the tumour. The section sliced off a small portion of an internal white growth present in the upper and outer half of the eyeball. There was very little solid growth at the site of the external tumour. The intra-ocular portion of the tumour extends from the ruptured staphyloma to within five millimetres of the optic disc. At and behind the staphyloma the sclera is destroyed and replaced by growth. About the equator the tumour extends inwards and reaches the optical axis of the eyeball; here the retina is incorporated with it. The retina is completely detached and stained with hæmorrhages. The optic nerve appears healthy. From the shape of the tumour it seems probable that it started to grow in the choroid.

Microscopically the tumour is seen to be a granuloma. It consists of round cells, epithelioid cells, and giant-

cells; the protoplasm of the last branch and anastomose with the protoplasm of the epithelioid cells. In one place there is slight caseation. No examination has beenmade for bacilli; nevertheless it is, in my opinion, a tubercular growth.

(*Card specimen. June 9th*, 1898.)

VI. INTRA-OCULAR TUMOURS.

Leucosarcoma of the choroid.

By Arnold Lawson.

(With Plate V.)

The growth is interesting on account of its snowy whiteness. Scarcely a trace of pigment can be seen. On section the tumour was found to be very dense in texture, and microscopical examination showed it to be a spindle-celled sarcoma, the cells being rather small, and very few blood-vessels apparent. The growth occupies the greater part of the choroid on the outer side, and could be easily seen by oblique illumination.

The patient was a man æt. 43, of a florid complexion, with blue eyes and sandy hair.

The history simply consisted of gradual loss of vision on the outer side of the eye for about six months. No pain or other subjective symptoms.

Examination revealed a circumscribed oval detachment of the retina close behind the lens. The detachment was traversed by large vessels, and was dotted with hæmorrhages, one or two being of considerable size. The tension was normal and equal in both eyes. The sclera was quite white, and there was no congestion of the anterior ciliary vessels. The media were quite clear, and except for the detachment the eye was perfectly healthy.

The circumscribed oval character of the detachment with the enlarged vessels and hæmorrhages, and the history of gradual and increasing blindness, together with the absence of any cause for simple retinal detach-

PLATE V.

Illustrates Mr. Arnold Lawson's Case of Leucosarcoma of the Choroid (p. 174).

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ment, such as traumatism, &c., made the diagnosis sufficiently clear.

The eye was removed three days after the examination.

It may further be noted that the anterior chamber was of normal depth, and that the tumour did not extend as far forward as the ciliary body. The optic nerve was also uninvolved.

(*Card specimen. October* 21*st*, 1897.)

Mr. Devereux Marshall said that he had had the opportunity of examining the specimen, and had never seen a case from which pigment was so markedly absent. The tumour was far more dense than most sarcomata met with in the eyeball, and did not seem to be particularly vascular.

VII. DISEASES OF THE ORBIT.

1. *Symmetrical tumours of orbits (recent).*

By H. Myddelton-Gavey, M.R.C.S.

Percy S—, æt. 15 years, a house-boy by occupation, presented himself at the Tunbridge Wells Eye and Ear Hospital on October 27th. He complained of swelling and fulness of the upper lids, and discharge from his eyes. He was found to be suffering from acute conjunctivitis, and on examination of the upper lids hard masses were found to be protruding beneath the upper margins of the orbit. These occupied in each eye about two thirds of the outer border, and could be felt projecting over the globe nearly half an inch. In the left eye its lower edge was smooth and rounded, and apparently about one third of an inch thick. In the right eye the lower edge was nodulated. Pressure caused no pain, and did not alter the position of the swellings to any extent.

He said that about a fortnight before the lids had become inflamed and swollen up like I saw them. I could get no history of pyrexia at the time. Have seen him some three or four times since. The conjunctivitis has yielded to treatment, and has disappeared; both the swellings are diminished in size and extent, and their retraction is towards the position of the lachrymal gland. The boy has hypermetropic astigmatism, and both discs are slightly hazy at their margins.

(*Card specimen. November 11th*, 1897.)

P.S.—The swellings completely disappeared after two months' treatment with iodide of potassium, 5 grains three times a day.

Mr. ADAMS FROST said that some years ago he showed before the Society a case of symmetrical enlargement of each lacrymal gland in a woman æt. 22 years. Those who saw that case thought the enlargements were enchondromata, or some form of sarcomata. He excised one of them and had it examined pathologically. The report said that it was round-celled sarcoma. The examination and issuing of the report took some time, and meanwhile the other gland subsided under iodide of potassium. It is probable that the case was syphilitic in nature.

Mr. MYDDELTON-GAVEY said that he had little to add to his notes of the case on the card. The diagnosis remained to be discussed. If the swellings, which he took to be enlarged lacrymal glands, were contemporary with the attack of acute conjunctivitis, which appeared to be the case, he presumed that there had been septic absorption by the lacrymal glands, and that their enlargement was due to exudation of some plastic material, which would take time to absorb. Certainly since the case had been under observation the swellings had slightly decreased in size, and had to some extent altered in character. In the left eye the edge, which at first was absolutely smooth, had become nodulated.

It had been suggested to him that this might be a case analogous to mumps, some such cases having been recorded. If, on the other hand, the tumours existed before the conjunctivitis they might be enchondromata, but this hypothesis would not account for their being symmetrical.

2. *Orbital pulsating tumour* (*meningocele ?*).

By Rayner D. Batten.

F. B—, æt. 9 months. In the right orbit on the nasal side is a long pulsating swelling, which apparently springs from the anterior part of the inner wall of the orbit. The margin of the orbit is defective, and has one or two bony spurs. The globe appears somewhat sunken, but this may be only apparent. There is no bruit or murmur to be felt or heard. The pupils react, and the child appears to see with both eyes. The present condition was noticed at birth, and has *not* increased. The child is quite healthy. No congenital defects. "The swelling increases on coughing."

(*Card specimen. October* 21*st*, 1897.)

July, 1898.—When last seen, about six months after, there was no alteration in the condition described.

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3. *Intra-orbital tumour* (*? secondary sarcoma*).

By N. C. Ridley.

Simeon W—, æt. 40, married.

History.—Some months ago R. eye was struck by the rebounding head of a hammer. The eye was swollen and prominent, but became smaller, though it never became quite normal. About the middle of September patient's child bumped his head against it. The next day it was swollen, and had about the same appearance as it has now. Vision getting worse in R. eye.

Condition October 19*th.*—Sent to the Leicester Infirmary by Dr. Skipworth, of Mount Sorrel. Considerable proptosis of R. No distinct mass to be felt in orbit.

No pulsation, no thrill, no bruit. No depression or swelling of orbital bones. Pupils equal and active. T. n. Slight haze of inner edge of R. disc, but no exudation nor hæmorrhage to be seen. Media clear. R. V. $< \frac{6}{60}$ $\bar{c}$ + 2 D. sph. = $\frac{6}{9}$. L. V. = $\frac{6}{6}$ $\bar{c}$ + 1 D. sph. = $\frac{6}{6}$. Little or no pain.

Treatment.—Shade. ℞ Pil. Hydrarg. Iodid. gr. $\frac{1}{8}$ t. d. s. Emp. Lytt. to temple if pain increase.

Course and further history.—Sight gradually failed. Optic neuritis much increased. On December 4th patient drew attention to three fluctuant swellings of the scalp, which he had discovered about three weeks before. December 8th patient complains of pain in L. shoulder. There is a mass of a rounded shape in the supra-spinous fossa. It has a peculiar crepitant feel at its most prominent part. There is also a rounded swelling of the R. fibula in the lower third. These last troubles are attributed by patient to an accident, where he fell on his shoulder and broke his leg, about two years ago. The leg has been broken at the same place twice since then. None of the swellings except those of the scalp seem to be increasing in size. Pre-auricular gland on R. side is enlarged and tender.

Present condition.—Patient seems much more feeble in health than formerly. Has a good deal of pain in shoulder and over ribs on the left side, especially on attempting to move the arm. Has had a cough, but it does not trouble him now. No affection of any other bones or parts than what has been mentioned above.

(*Card specimen. December 9th,* 1897.)

P.S. (July 1st, 1898).—Dr. Skipworth's report. After visit to London, patient got rapidly worse, he got thinner, the tumours increased; he took to his bed, and appeared to be dying. Two months ago all the swellings subsided in a marked manner, the right eye seeming almost like the left. They again increased in size and became bigger than ever, but the patient's health is better, appetite good, and he can walk about a little.

Present condition.—Patient has lost flesh, and is bent like an old man. He is very cheerful, however. Complains of "rheumatic" pains in back and limbs at night. It has not been necessary to give him morphia. *Right leg.*—Swelling as before, or very little larger. *Shoulder.*—Much larger. Cannot raise arm from side. *Head.*—Four large, soft, non-pulsatile swellings, the largest as big as a Jaffa orange, the smallest as a Tangerine orange. *Right eye.*—Large rounded definite swelling, especially at outer and upper parts of orbit. Proptosis = 18 mm. (measured). Globe directed downwards also. Lagophthalmos. R. V. = fingers at 1 m. Enlargement of pre-auricular gland, and also of the lymphatic gland on the ramus of the jaw, close to the facial artery. The conjunctival irritation due to the lagophthalmos seems to trouble him more than anything else.

Advised.—Shield made of lint greased with Ung. Ac. Boric. ; Lot. Ac. Bor. p. r. n., Morph. Inject. hypoderm. s. o. s.

Mr. Jessop said there was one point of interest in the case which he would like to clear up, viz. how often a growth in the orbit was found secondary to growth elsewhere. Mr. Vernon had at present under his care a man who had a spindle-celled sarcoma in his back, and then had a swelling on the outer side of the orbit. As far as he knew, when there was a swelling in the temporal fossa it was always malignant. He would be glad if some other member could give information about the frequency of sarcoma elsewhere than in the orbit.

Mr. Eales said he thought he ought to mention two cases, as Mr. Jessop had put two points very strongly. In one case, in a man of about 35, a tumour occurred in the orbit as a secondary growth, the leg having had to be amputated above the knee for a growth which recurred ; the leg was subsequently amputated at the hip-joint. The man came under him with a large protrusion of the eyeball, the orbit being filled with a growth which

also involved the temporal region; moreover he had a growth in the left sterno-clavicular articulation. He did not do anything in the case, and did not know how long the man lived. The other was a very curious case *àpropos* of Mr. Jessop's remarks as to whether swellings in the orbit and temporal region were of necessity always malignant. Six or seven years ago he had under his notice a young woman who had a sudden rapid proptosis accompanied by a boggy swelling over the temporal region. He made one or two deep incisions into the orbit without finding any pus, or anything abnormal. Then he thought it well to introduce the knife below the zygoma to see if there was any pus there, but the result was negative. He therefore brought the case before a general surgeon, Mr. Chevasse, who concurred in the view that it was probably a malignant growth rather than an abscess, and as it involved both the temporal fossa and orbit they did not feel justified in operating, and she was sent home. Some few weeks afterwards a doctor, who saw her constantly, scarified her chemosed conjunctiva, and in doing so one day some bloody purulent material escaped, after which the orbital and temporal swellings rapidly went down. He had not seen the case since, but she was on the way to cure, which made malignancy doubtful.

Mr. Nettleship said he had no case which bore fully on the question asked by Mr. Jessop, but he had had a case in a child where a sinus starting in the upper lid, which used to fill up and open again, was found on exploration to communicate through a hole in the temporal bone with a boggy swelling in the temple.

4. *Tumour of lacrymal gland.*

By E. H. Holthouse and R. D. Batten.

The patient from whom the growth was removed was a man aged 31. Two years ago he received a blow on the left eye which he had cause to remember. Six months ago he first noticed the eye getting bigger.

Left eye.—Proptosis; globe pushed down; ocular movements fairly good, slightly limited outwards; diplopia on upward movement. Unable to completely close the lids.

Pupils equal, active.

V. { R. $\frac{6}{9}$.
L. $\frac{6}{60}$—$\frac{6}{36}$, 1 letter.

A lobulated tumour felt in the upper part of the orbit, extending from the outer to the inner margin; it appears closely applied to the roof of the orbit. No pulsation. No pain on pressure.

The growth was removed fairly easily, and shelled out completely encapsuled. No further growth was felt in the orbit, and no lacrymal gland found. Five days after removal, V. L. = $\frac{6}{18}$, 3 letters. Hm. +1.

The growth is composed of proliferating glandular cells varying in size and shape, some being cylindrical, others cubical, and others again of irregular shape. The alveoli formed by these cells lie embedded in a stroma of loose fibrous tissue, in parts appearing myxomatous.

There are numerous large spaces filled with colloid material.

(*Card specimen. March 10th*, 1898.)

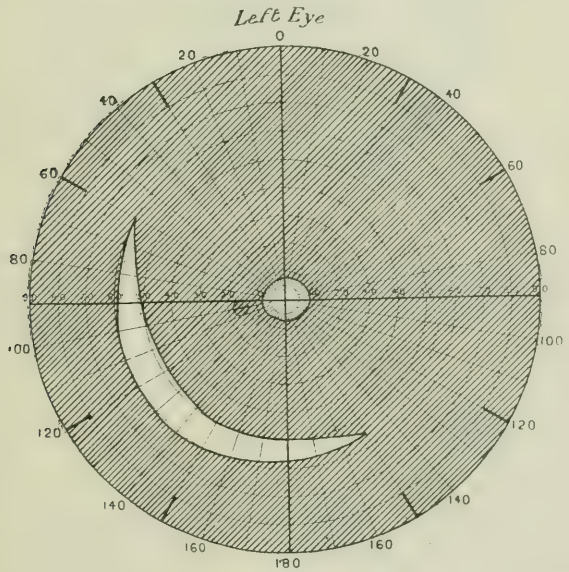
VIII. CONGENITAL ABNORMALITIES.

1. *Deficiency of the choroid.*

By J. F. Bullar.

The sight has always been bad. The two eyes are practically alike. The greater part of the fundus appears of a greyish white with scattered pigment spots.

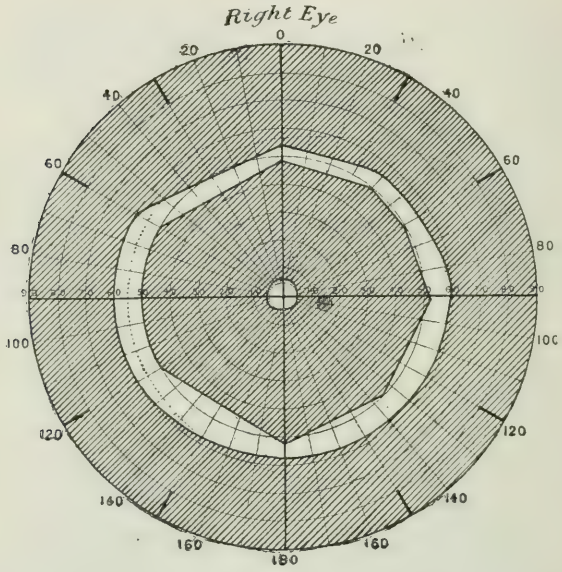
Fig. 26.



The ordinary red reflex of the choroid is limited to a small patch in the macular region and around the disc. Some isolated choroidal vessels may be seen, and in the

peripheral parts of the visible fundus there is a faint red tinge. The visual fields consist of a small central part

FIG. 27.



of less than 10°, and of a peripheral part consisting in the right eye of a narrow ring, and in the left eye of a narrow crescent. See Charts, taken in December, 1892.

The vision was then $\begin{cases} \text{R. } \bar{c} - 5{\cdot}50 \text{ D. } \frac{6}{18}. \\ \text{L. } \bar{c} - 5{\cdot}50 \text{ D. } \frac{6}{12}. \end{cases}$

The V. is now $\begin{cases} \text{R. } \bar{c} - 7 \text{ D. } \frac{6}{18}, \\ \text{L. } \bar{c} - 7 \text{ D. } \frac{6}{9}, \end{cases}$

and the V.F. appears to be unchanged. Parents not related. Two sisters and two brothers can see well. Two brothers have bad sight.

(*Card specimen. October* 21*st,* 1897.)

2. *Congenital corneal opacity with buphthalmos; subsequent condition.*

By R. Marcus Gunn.

The patient was first brought to hospital when three weeks old. The history then given was that the eye was "thick blue" at birth, and had been getting clearer since. There was an eruption on the body one week after birth; the fingers and body peeled afterwards.

Condition at first examination.—Both corneæ are hazy, especially the left; A.C.s very deep; buphthalmos. The iris seems well developed; pupil rather small, but round. Ordered Ung. Flav Dil. c̄ Atrop.

Three months later (4 months old).—Corneæ clearing. Has had snuffles very badly. Ordered Hyd. c̄ Cret. gr. ½, t. d.

About a year later.—Corneæ becoming clear. A.C.s very deep. Corneæ very large.

Five and a half years later (6½ years old).—She now returns. There has been no treatment of the eye since 1892.

The corneæ now look quite clear, but on careful focal light examination there is a faint haze of right cornea; on magnifying, there are seen numerous minute separate points of opacity. Pupils dilate moderately well under atropine, quite regular. Choroid normal. Optic discs show large physiological pits, but there is not glaucomatous excavation. There is constant lateral nystagmus. Vision fairly good. Counts fingers at six feet.

(*Card specimen. November 11th*, 1897.)

The Chairman (Dr. Berry) said the interest in the case was the connection between the opacity of the cornea and the buphthalmos. He did not know that it was a common thing; certainly he had never himself seen the clearing up of a cornea congenitally opaque, and leaving such a marked condition as in this case. Possibly some members of the Society might have seen similar cases.

3. *Congenital tumour of upper eyelid (? supernumerary caruncle.)*

By J. W. H. Eyre, M.D.

(With Plate VI, fig. 3.)

E. C—, female æt. 13. Congenital tumour of the left upper eyelid.

History.—The tumour was stated to have been present at birth; to have gradually increased in size for some years, but not lately. Patient complained of a certain amount of watering of the eye, but beyond this the tumour caused no real inconvenience. Its removal was chiefly desired for cosmetic reasons.

Condition on examination.—Left eye.—A small, almost spherical, sessile tumour situated at the inner extremity of the intermarginal space of the upper eyelid, occupying the interval between the punctum lacrymale and the inner canthus, and projecting (*vide* Fig. 1) into the interpalpebral fissure when the lids were open. When, however, the lids were closed the tumour appeared to be retracted, and was invisible except for the slight prominence of the skin surface, such as might be produced by a tarsal cyst, which marked its situation.

The tumour, which was about 5 mm. in diameter, was of a pinkish colour, firm in consistence, continuous with the skin at its base, and not attached to the tarsal cartilage beneath, over which it was freely moveable. The surface, moist, glistening, and covered by conjunctiva, was pitted with numerous follicles; with the aid of a lens a few fine silky hairs could be seen projecting from its surface. On everting the upper lid a definite process from the tumour could be made out, extending from the base of the main body vertically upwards towards the retro-tarsal fold for about 1 cm. (Pl. VI, fig. 3).

Microscopical examination.—The tumour, having been

ablated by means of a pair of curved scissors, was fixed in a saturated solution of $HgCl_2$, hardened in alcohol, embedded in paraffin, and sections cut at right angles to the base of the tumour. These were stained and examined microscopically. The appearances were practically identical with those found in a similar case I have previously recorded in the 'Archives of Ophthalmology' (vol. xxvi, No. 3, 1897). The free surface of the tumour is composed of a layer of stratified pavement epithelium, several cells thick, like that of the scleral conjunctiva, and perforated by hair-follicles. The main substance of the tumour consists of connective tissue, traversed by bundles of striated and smooth muscle-fibres. Here and there one notes masses of mucous gland tissue, and sebaceous glands may be seen in connection with the hair-follicles, the *tout ensemble* differing in no respect from that presented by a vertical section of the normal caruncle.

(A similar case was recorded by Stephenson in the 'Ophthalmic Review,' vol. xv, January, 1896.)

(*Card specimen. March 10th*, 1898.)

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4. *Symmetrical lenticular congenital opacities.*

By Rayner D. Batten.

(With Plate VI, fig. 1.)

In both eyes there is with *focal* light a symmetrical circular opacity, divided into three equal segments, leaving a triangular clearer portion in the centre.

The opacity appears to be situated towards the posterior portion of the lens.

Its appearance varies somewhat according to the direction of the focal light.

With direct examination and transmitted light only a

very few fine opacities can be detected. The details of the fundus are seen clearly through it.

Patient a girl æt. 20.

V. $\begin{cases} \text{R.} - 5\,\text{D.} = \frac{6}{12}, \text{ J. 1 at 6.} \\ \text{L.} - 6\,\text{D.} = \frac{6}{18}, \text{ J. 1 at 6.} \end{cases}$

Fundus examined. No myopic crescents.

(*Card specimen. March 10th*, 1898.)

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5. *Atypical development of the vitreous; persistent hyaloid artery.*

By N. C. Ridley and C. Devereux Marshall.

Harry H—, æt. 11 months, was seen at the Leicester Infirmary. The parents had noticed a peculiar appearance about the left eye since birth, and they thought it was painful. A mass was easily seen lying just behind the lens to the inner side. It was of irregular outline, white in colour, but having a patch of pigment at its base. The pupil was circular, equal to that on the right side and active. It dilated easily with atropine. The fundus appeared normal, but was not well seen owing to the restlessness of the child. The tension was normal. The eye was watched for two months, at the end of which time the mass seemed a little larger, and the mother thought the child suffered pain at times. It was therefore removed and hardened in formol.

Pathological examination.—The cornea is clear. A.C. normal. When the eye is held up to the light a small opacity is seen far forwards and to the inner side.

Eye frozen and divided in an antero-posterior direction. The lens is not regular in shape, and is much more rounded at one end than at the other. On the same side the retina is detached and much thickened. It leaves the choroid far back, and reaches forwards to become attached to some dense connective tissue which is situated

behind the lens, and which is attached to its rounded extremity. The ciliary processes are greatly atrophied, and some white spots are scattered over the retina. There is a persistent hyaloid artery running to the edge of the patch of fibrous tissue behind the lens, that lies towards the centre of that structure. This artery springs from one of the retinal vessels at a distance of four mm. from the disc, and between the disc and the retinal detachment. The detachment of the retina does not end at the ora serrata, but the pars ciliaris retinæ takes part in it too, and the cleavage is continued to the edge of the pupil, the two pigmented layers of the iris being separated over a considerable area.

Microscopic examination.—The cornea is healthy, and the iris, which is greatly atrophied, is separated on each side from its attachment to the ciliary body; the latter is small and atrophied. The central portion of the lens has a laminated appearance, and has some opacities in it. At the periphery it is vacuolated, and the fibres are not arranged regularly. On one side, where the remains of the hyaloid artery reaches it, there is a stretched-out mass of connective tissue forming a cup, in which the equator of the lens on this side rests. This is continued backwards into the retina, which is vacuolated and degenerated. The choroid is also thin.

(*Card specimen. May 5th,* 1898.)

6. *Arrested development of the iris associated with defect in the dental enamel of the permanent teeth, and a history of infantile epileptiform convulsions.*

By John Griffith.

(With Plate VI, fig. 2.)

F. P—, æt. 10 years, has arrested development of both irides. The condition has been noticed since birth.

Between four and five months old she had four or five "fits," none before or since. They were attributed to "teething." She has one brother, G. P—, with a similar congenital defect (see next case).

Her teeth show in a very marked manner how imperfect is the development of the enamel.

Her mother has only had one other living child, who died when six weeks old from some abdominal complaint. The fourth conception miscarried at the third month.

She has myopia, amblyopia, and photophobia. The iris defect is seen in Pl. VI, fig. 2; it resembles a large coloboma, including the whole pupillary zone. The lenses are quite transparent, and appear to be slightly dislocated upwards. The fibres of the suspensory ligament are visible below. There is no congenital defect of the choroid or ciliary body.

The vision in each eye is not improved beyond $\frac{6}{24}$ Snellen.

(*Card specimen. May 5th,* 1898.)

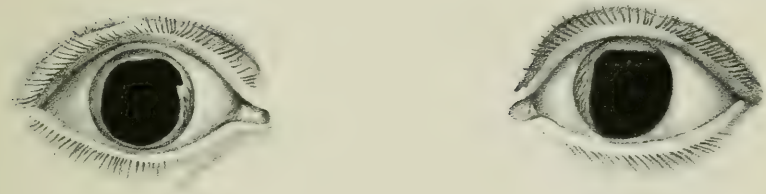
PLATE VI.

Fig. 1 illustrates Mr. Rayner D. Batten's case of Symmetrical Lenticular Congenital Opacities (p. 187).

Fig. 2 illustrates the appearance of the two eyes in Mr. John Griffith's case of Arrested Development of the Iris associated with Defect in the Dental Enamel of the Teeth, and a history of infantile epileptiform convulsions (p. 190).

Fig. 3 illustrates Dr. J. W. H. Eyre's case of Congenital Tumour of Upper Eyelid (? Supernumerary Caruncle) (p. 186).

M. H. Brooks, del. Fig. 1.



J. Griffith, del. Fig. 2.

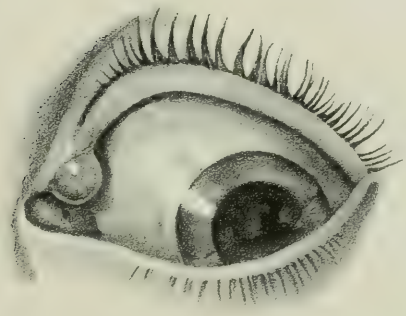


Fig. 3.

Bale, Sons & Danielsson, Ltd., Lith.

7. *Arrested development of the iris associated with anterior polar cataract, and a history of convulsions in infancy.*

By John Griffith.

G. P—, æt. 6 years, brother to Case 6, has a similar defect in each eye. Had two "fits" when he was about eleven months old.

In both lenses there is an anterior polar opacity of congenital origin. The lenses also appear dislocated upwards to a slight extent.

The only permanent teeth that have erupted are the first molars. It seems probable that when the incisors and canines appear they will show a similar defect in the enamel as is seen in Case 6.

His vision, so far as it is possible to ascertain, is also defective.

(*Card specimen. May 5th,* 1898.)

Mr. Sydney Stephenson said that some little time since he showed two brothers before the Society who had irideremia, and it might to some extent be helpful to know that in each case a limited deficiency of the enamel was present, that condition which he believed was known to dentists as hypoplasia.

IX. INJURIES OF EYE AND ORBIT.

1. *Radiographs of shot in the left orbit.*

By T. H. Bickerton.

(With Plate VII, fig. 1.)

History.—C. S—, æt. 17, on Sept. 13th last, while grouse driving in the Highlands, was struck in the left eye by a stray pellet (No. 5 shot) which penetrated the globe. Two hours later the wound was probed by a local doctor, the probe being passed right into the vitreous. Twelve hours after the accident, was seen by Dr. Berry, to whom I am indebted for the early notes of the case. He found "a very considerable amount of chemosis and proptosis, as well as complete blindness from hæmorrhage into the vitreous." Strong chlorine water was injected subconjunctivally, and conjunctiva transplanted over the external wound. The treatment up to this time consisted of iced antiseptic lotions applied continuously, with instillation of atropine. The subsequent treatment was frequent irrigation with warm boracic acid lotion, bandaging, and rest in bed for a week, the atropine being continued once daily. Steady improvement followed, and "at no period has there been lymph formation or ciliary tenderness." The blood in the vitreous has undergone partial absorption, and on October 16th, when the youth left Scotland, "he could count fingers at three or four feet, and had a good field except above."

Present condition—left eye.—Cicatrix with surrounding redness at centre of lower ciliary region. No injury of lids, iris, or lens. The pupil is dilated (atropised) and oval vertically, the iris being wider on the outer than on the inner side, and a shade greenish in colour.

There is much hæmorrhage, seen as linear streaks in

FIG. 1.

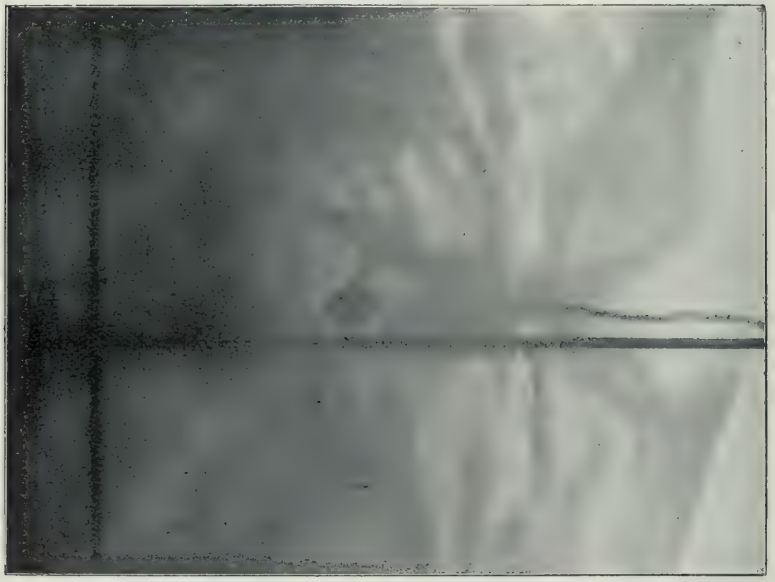


FIG. 2.

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PLATE VII.

Fig. 1.—Radiograph of Shot in the Left Orbit (Mr. T. H. Bickerton's case) (p. 192).

Fig. 2 illustrates Messrs. Mackenzie Davidson and E. Treacher Collins' paper on the Localisation of Foreign Bodies in the Eye and Orbit by the Röntgen Rays (p. 200).

the vitreous, which converge in a radial manner from the periphery to a white patch of denuded sclerotic situated just below and to the inner side of the optic disc. From this white patch a narrow line of white denuded sclerotic can be seen running downwards towards the periphery in the direction of the wound, whilst passing forward from the patch into the vitreous, through which the disc can be hazily seen, is a whitish cloud-like film.

Tension.—a shade *minus?*

Vision.—$\frac{1}{36}$ $\bar{c}$ + 4 sph. J. 14.

The immediate proptosis and the subsequent continuous improvement led Dr. Berry to believe that the pellet had traversed the globe, and was lodged somewhere in the orbit. The denuded scleral patch now to be seen on the fundus confirms, I believe, this view. In order to obtain, if possible, more definite evidence, I asked my friend, Dr. Holland, to take radiographs in several directions, with the satisfactory results as shown.

Radiograph No. 1.—Crookes' tube placed slightly in front of and above the face, so that the rays were directed downwards and backwards, passing through the nose and left orbit only. The shadow of the pellet is seen *behind* the upper part of the vertical limb of a cross-shaped bony shadow, and on level of root of nose (Plate VII, fig. 1).*

Radiograph No. 2.—Here the X rays were directed straight through from side to side, passing through both orbits. The shadow of the pellet is now seen as a darker shadow lying *on* the upper end of the vertical limb of the cross-shaped bony shadow, the level being a shade higher than in No. 1.*

[Radiographs 3 and 4 were experimental, with a skull and a No. 5 shot, in order to try and localise position of the pellet.]

Radiograph No. 3.—The shot was placed in the orbit on its outer wall, lying against the malar bone, and the

* The time of exposure was fifteen minutes for No. 1, twenty minutes for No. 2, a 4-inch spark being used.

skull and rays arranged as for radiograph No. 1. The shot is seen at the upper end of the vertical limb of the cross-shaped bony shadow, its size being but slightly exaggerated: the level is about the same as No. 1.

Radiograph No. 4.—The shot was placed in the anterior ethmoidal foramen, and the skull and X rays arranged as for radiograph No. 2. The shadow of the shot is now seen behind the upper end of the vertical limb of the cross-shaped bony shadow, and on a higher level than No. 3. Its size is larger than in No. 3, owing to greater distance from the plate and divergence of the rays.

Conclusions.—By comparison of these radiographs the pellet is seen to be on a level with the root of the nose (fronto-nasal suture), and therefore extra-ocular. Its situation in relation to the side walls of the orbit is doubtful.

(*Card specimen. November 11th*, 1897.)

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2. *Case of leaden pellet lodged in the eyeball, with skiagraph.*

By Gustavus Hartridge.

(With Plate VIII.)

William E—, æt. 18, was admitted into the Westminster Hospital about 1.30 p.m. on November 6th, 1897, with a gunshot wound of the right eye. He gave the following account of the accident. "About 11 a.m. that morning he was working in the stable while some of his fellow-grooms were practising with an air-gun at a target; being between the shooter and the target with his back towards the latter, he was told to stoop down in order that the gun might be fired over him. He did so, but at the same time turned his head to the right so as to see what was going on, and at that moment he was struck by the pellet in the right eye." On his arrival at the hospital he was seen by the house surgeon, who

Printed and Engraved by Bale & Danielsson Ltd., London.

PLATE VIII.

Skiagraph of Mr. Gustavus Hartridge's case of Leaden Pellet lodged in the Eyeball (p. 194).

snipped off a large prolapse of the iris and applied a cold compress; when the patient was seen next morning we noted a somewhat jagged linear wound about eight mm. long, extending across the cornea in a horizontal direction, and occupying the junction of the lower and middle thirds; the anterior chamber was full of blood, and there was a considerable amount of chemosis. No p. l. T – 1.

The boy thought the bullet was picked up after the accident, but no reliance could be placed on this statement, especially as a good many shots had been fired, and there were several pellets lying about amongst the straw.

Four days later the chemosis had much diminished, there was less blood in the anterior chamber, the iris was entangled in the wound, the lens was becoming opaque, and there was no perception of light. A skiagraph was taken, the photographic plate being placed on the right side of the head and the Crookes tube over the left side, so that the rays traversed the skull from the left temporal region to the right; the skiagraph showed the position of the bullet near the centre of the orbit, but since no outline of the globe was present one could not be quite sure that the foreign body was in the eye itself, but as the organ was hopelessly lost enucleation was resorted to, and the pellet was found in the centre of the globe as shown in the specimen, which was kindly mounted by Mr. John Griffith.

(*Card specimen. December 9th*, 1897.)

The PRESIDENT said this was to him a very interesting case, as he happened to have at present under his care a gentleman who got a leaden pellet in his eye from a snipe shot. In this case they had no doubt that the pellet was in the eye, and the aid of the X rays was not required to tell them so; yet he thought it would be desirable to employ the rays for the satisfaction of the patient and his friends, and by means of them they easily saw that the pellet was present. Moreover it was easy to tell that the pellet was in the eye, and not in the orbit,

because the foreign body moved when the eyeball moved. He had had another case in which the pellet was in the orbit, which they recognised by the fact that the pellet did not move when the eyeball was moved. There could be no doubt that in many cases the X rays were an exceedingly important method of ascertaining such facts with certainty. He asked for experiences of members on the subject.

Mr. Bullar said he had not such a good specimen as they had seen, but the skiagraph which was taken by Dr. Aldridge, of Southampton, showed the cap quite plainly. The patient, a boy, was trying to get the cap out of a cartridge; the cap exploded and wounded the eye about $\frac{1}{8}$ inch outside the cornea, and the vitreous was protruding. There was too much blood in the anterior chamber to permit him (Mr. Bullar) to see anything at the moment, and the question arose whether the cap was in the eye. To him it seemed very likely that it was there. Mr. Power and Mr. Vernon saw the case, and thought the cap was probably in the eye. He (Mr. Bullar) had almost made arrangements to excise it, but it got a little better. The condition had now cleared up, and the vision was $\frac{20}{70}$. The radiograph showed the cap, but he felt sure it was not in the eye itself; there was a red patch of conjunctiva at the outer canthus, which looked as if the shot was in the outer part of the orbit. He saw a man two years ago who was struck in the eye by a chip from a rifle bullet, which penetrated the cornea and the lens. The piece could be seen quite plainly. The man being in the army was particularly anxious not to lose his eye. He (Mr. Bullar) therefore decided, as the eye was quiet, to do nothing, but warned the man to come to him if the eye gave trouble. The eye has been perfectly quiet since the accident two years ago, and the only trouble is the loss of sight, due to the gradual formation of traumatic cataract.

Mr. Power said he had had an opportunity of seeing the case first mentioned by Mr. Bullar, which was a very

interesting one in many ways. The cap inflicted a severe wound in the sclerotic, and the question was whether a fragment had entered the vitreous or not. He thought they were a little too frightened about the chance of sympathetic ophthalmia occurring. They all knew the terrible nature of that disease, but they should be tolerably certain a foreign body was in the eye before deciding on excision of the organ. On one or two occasions he had extirpated an eye for gunshot wound, but had very much regretted it afterwards, the shot having traversed the globe. The practice followed at St. Bartholomew's Hospital, if the patient could be kept under observation, was to wait three weeks to a month, before which period he did not think there was much risk of the occurrence of sympathetic ophthalmia. He remembered a cabman coming to the hospital (who had already lost the sight of one eye) in consequence of trouble with another cabman, who gave him a severe blow on the other eye, rupturing it, and the vitreous exuded. The eye was soft and collapsed, and no surgeon would have been considered hasty if he had removed the eye. But as he had previously had only one sound eye, he (Mr. Power) thought he would try to preserve it; he therefore brought the edges of the wound very carefully together with four or five stitches, and, to his astonishment, the man recovered enough vision to find his way about. There was no question of a foreign body in that case, but for such an angry and severe wound as that to get well encouraged them to wait, and do what else they could before doing excision.

Mr. Bickerton said he showed a case at the previous meeting which was sent to him by Mr. Berry. The question had been whether the shot was in the eye or not. Mr. Berry thought the shot had gone right through the globe, because the blood in the posterior chamber had cleared up so well. The skiagraph showed the shot, which was extremely small—smaller than in Mr. Hartridge's case—in the socket. In order to ascertain the position of the pellet, whether in the eye or in the socket,

experiments were made with a skull in which pellets of No. 5 shot were variously placed and then skiagraphed. The eye had been left alone, and improvement had been steady, for from vision being *nil* the young man had now $\frac{3}{24}$. Since showing that radiograph he had seen two other radiographs. In one case it had been a question whether a piece of steel had lodged in an eye. Its position was diagnosed by the radiograph. The eye was taken out and the steel was found. In the other case, that of a gentleman shot five or six years ago, a radiograph seemed to point to the lodgment of a fragment in the lens. In the case of eye injuries by foreign bodies there was no doubt but that the X rays were going to be very valuable, and the case brought forward by Mr. Hartridge was extremely interesting.

Mr. Johnson Taylor asked whether it made very much difference whether the shot was in the eye or in the orbit. The President had narrated a case in which a snipe shot had been in the eye for a considerable time. He presumed the eye had been, or was being, saved. Some members might remember that in the 'British Medical Journal' for January Mr. Brudenell Carter narrated a case in which two snipe shots entered the eye, both penetrating the lower lid. The case was watched; the lens was not injured, and the vitreous had quite cleared up. That happened, he believed, in 1895, and the young gentleman who was injured was now at a public school, and had $\frac{10}{12}$ of normal vision. Weeks after the injury Mr. Carter could distinctly see shots in the sclerotic. Every now and then he (Mr. Taylor) came across a case of gunshot injury of the eye. Since the last meeting of the Ophthalmological Society he had a man who had been struck in the eye by a shot fired at 100 yards. But as shots were supposed to be aseptic, and one of the cases had got on well with the shot in the eye, he wished to know whether it was such a very serious matter and would make so much difference (supposing the ciliary region and the lens were not in-

jured) whether the shot was in the eye or not. In other words, ought they to excise eyes containing shot?

Mr. Holmes Spicer said he had a case recently under his care which was interesting as showing the value of the X rays. A man attempted suicide by firing two bullets simultaneously into his temples. There was rupture of the choroid of each eye and some intra-ocular hæmorrhage. The man, with the exception of losing his sight, seemed no worse off. It was a matter of serious difficulty to find out where the bullets were, and the man was accordingly taken to a laboratory and examined with X rays by a very competent observer. The position of one bullet was located with confidence, but not two. The patient had to travel some distance to undergo this examination, and it rather upset him, although it was six weeks after the injury. When he returned from the examination he got an attack of suppurative meningitis, from which he died. At the post-mortem no trace of the bullet could be found at all, so that the X rays had not told the truth in that case.

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3. *Chip of steel in vitreous; rust-coloured deposit beneath anterior capsule of lens (no wound of lens).*

By W. G. Laws.

Immediately beneath the anterior capsule of the R. lens there is a deposit of fine rust-coloured particles; some of these are diffusely scattered, others are aggregated into radially arranged streaks, and there is an irregularly circular patch at the centre.

In the deeper parts of the lens there is a good deal of opacity, composed of large vacuoles.

E. C—, æt. 31. About middle of May, 1896, R. eye struck by a chip from a hammer; no symptoms were noticed for three months; the R. pupil was then observed to be slightly larger than the L. First seen August 24th,

1896. R. quiet, V. $= \frac{6}{6}$ nearly. Small scar 2 mm. to nasal side of cornea. Pupil 6 mm. (L. 4 mm.). Lens clear. A good deal of opacity in lower part of vitreous; some bright flakes near region of wound of entrance. Attached to retina at outer side a yellowish-white body, about $\frac{2}{3}$ disc area in size, surrounded by granular opacity of vitreous with some bright flakes.

Seen in September, October, November, December, 1896, and February, 1897, and no material change noted except that in February the iris was slightly darker in tint than the left.

On September 14th, 1897, R. V. $= \frac{6}{12}$ partly. Eye quiet. Opacities in the lens (as at present). The yellowish-white body in the vitreous at outer side can still be seen, but appears to have partially broken up.

(*Card specimen. December 9th*, 1897.)

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4. *On the localisation of foreign bodies in the eye and orbit by the Röntgen rays, with illustrative cases.*

By Mackenzie Davidson and E. Treacher Collins.

(With Plate VII, fig. 2.)

(i) *Method of localisation by Mackenzie Davidson.*

Having recently devised a method and apparatus for localising foreign bodies by means of the Röntgen rays, I applied it to their detection in the eyeball with such encouraging results that I thought I might venture to bring the matter under your notice to-night.

I have to thank Messrs. Nettleship, Waren Tay, Lawford, and Myddelton-Gavey for sending me suitable cases. I am also indebted to Mr. Treacher Collins for the great interest he has taken in the work, and he will give you the details and results of some of the cases.

There are special difficulties, in connection with eye cases, to which I shall presently more particularly allude,

and it will be best, therefore, for me to deal with the subject generally before describing in detail its application to the eye.

Röntgen rays resemble light inasmuch as they travel in straight lines, they affect a photographic plate, and they cause certain substances to fluoresce. But they differ from light in that they are not subject to refraction, diffraction, or polarisation, and they can only be reflected from some substances in a very small proportion and then only in a scattered form, just as light is reflected from white paper.

The point of importance in any method of localisation by their means is the fact that they are not refrangible, and that therefore they pass through the various media of different densities, at whatever angles, in straight lines, radiating from their point of origin (the anode of a Crookes tube). The heavier metals and glass are very opaque to these rays, hence shadows are cast of particles of any of these substances embedded in the human body.

It is obvious that the first step in any attempt at localisation must be to take two or more photographs (or skiagrams) with the Crookes tube displaced to different positions. Several ways of doing this have been described, but they all shared one disadvantage, viz. that the interpretation of the resulting skiagrams required the use of mathematical calculations, or geometrical drawing to scale, before the final practical result was attained of being able to inform the surgeon where and how he was to find the foreign body.

It fortunately occurred to me to use fine silk threads to trace the paths of the Röntgen rays, which had produced two skiagrams taken from two different points of view, and this at once gave accurate and reliable results, and involved only the use of a pair of compasses and a scale. If a foreign body, however small, is embedded in a *rigid* substance like solid paraffin, it can be located with extreme accuracy by this method; but our bodies are not rigid, our muscles and skin change

their relative positions to each other and to the bones, according to the position of the parts and to the superficial pressure, and this element of mobility is a difficulty in localising in any part of the body; but the eyeball being so freely moveable, and the foreign bodies embedded in it often so small, special precautions have to be adopted to overcome this difficulty.

I have described and illustrated the method of localisation in the 'British Medical Journal' of January 1st this year. At present I need only consider the general principles upon which it is based.

Two photographs (or skiagrams) are taken from two different points of view.

The anode of the Crookes tube (*i. e.* the point of origin of the X rays) is placed vertically at a measured distance from a point where two wires cross each other at right angles. A photographic plate, enclosed in black paper envelopes as usual, is placed beneath these cross-wires. The wires are brushed over with ink so as to mark the patient's skin. The tube slides along a horizontal bar which is placed parallel to one of the wires. It is displaced to a measured distance to one side and an exposure given, then to a corresponding point on the opposite side and another exposure given. The result is a negative which shows one image of the cross-wires and two images of the foreign body.

The negative is then placed upon a glass horizontal stage (which may be called the X ray localiser); a mirror reflects the light from below up through the negative. The adjustments are now repeated, only that a fine silk thread is made to come from the point occupied by the anode of the tube in one exposure on to the shadow of the foreign body it produced, and another thread traces the path of the ray, when the tube was displaced to the other position, to its corresponding shadow of the foreign body. It follows that the point where the threads cross each other fixes the position of the foreign body in relation to the plate and to the images of the cross-wires.

These measurements can then be applied to the patient's body as the cross-wires left their mark upon the skin.

In the first case in which I tried to localise a foreign body in the eyeball the patient was made to lie upon his side, and the photographic plate was placed upon a stool which acted as a rigid pillow. He was made to fix his eyes upon a small piece of paper fastened with a drawing-pin to the wall. It proved a failure so far, on account of the difficulty of working from the uncertain position of the plane of the plate on his temple, although subsequent experience proved that even with that disadvantage we could have fixed the position of the foreign body more accurately than we did at the time.

The following plan gives reliable results. The patient sits upright in a chair, the back of his head rests against a board. The side of his head (with the eye to be photographed) rests against two knitting-needles which are placed at right angles to each other across a wooden frame. He is made to fix his eyes on a distant object, and a small piece of lead wire is made to touch and mark the lower eyelid at a point which bears a definite relation to some point of the eyeball, such as a scar, &c. The Crookes tube is arranged to slide horizontally parallel to the horizontal knitting-needle. Two skiagrams are taken, on the same plate preferably, if possible, or one upon a plate and the other upon a celluloid film which allows of their being superimposed for localisation purposes, the perpendicular distance of the anode being noted from the point where the knitting-needles cross each other, and then the displacement of the tube to each side of this, for each exposure, is also recorded.

When the negative is placed upon the localiser, we first determine the position of the point of the wire that rested on the lid, and leave a needle with a fine point to indicate this position. We then ascertain the position of the foreign body and we can thus find out the distance and direction of the foreign body from the mark on the lower eyelid when the eye is placed in the same position

as it occupied when the skiagrams were being taken. It is thus possible to ascertain the position of a foreign body in the eyeball or orbit with considerable accuracy, and also to give its size to within one twenty-fifth to one fiftieth of an inch.

In one of Mr. Treacher Collins' later cases this was proved. And in Mr. Lawford's case, where the eyeball had to be removed, a particle so small as $1\frac{1}{2}$ by $2\frac{1}{2}$ millimetres was located, and the sizes in the two diameters I had estimated at 1 by 2 millimetres—an error of one fiftieth of an inch. Mr. Lawford kindly gave me the particle, which I will now hand round for your inspection.

In conclusion we would claim for the Röntgen rays in ophthalmic surgery,—

1st. They enable us to decide if a foreign body (opaque to them) is present in the eyeball or not.

2nd. If there be a foreign body present, it can be located and its size estimated to within a reasonable degree of accuracy for all practical purposes.

3rd. There is no risk in the use of the X rays provided the exposures be not too prolonged. This need never be the case if a different plate be used for each of the two exposures. Two minutes for each gives a total of four minutes with the anode of the tube 30 centimetres from the plate, and this is far within the limits which might produce a dermatitis or a loss of hair.

With reference to the patient shown to-night with partial loss of hair due to exposure to the Crookes tube, I wish to remark that at the time the tube I was using was not giving out X rays as well as usual, and the repeated exposures were due to my endeavouring to get the two photographs taken from the two points of view *on the same plate*. But I now use two plates, and the exposure is thereby shortened and has not generally to be repeated. With a tube in good order two may be successfully given on the same plate.

I will now demonstrate the apparatus, and exhibit some slides illustrating these remarks.

(ii) *Illustrative cases.*

By E. Treacher Collins.

Mr. Mackenzie Davidson has described to you the method he has introduced for the localisation of pieces of metal in the eyeball and orbit by means of the Röntgen rays. The part of the subject to which I have now to invite your attention is its practical utility. This I can best do by describing a series of cases in which it has been applied.

The first case is one which we greatly regret was not our last, because we feel sure that had the patient presented himself now, with the improvement which has been effected, and the increased confidence we have gained in the method, we should have a brilliant success to record. Had we been able to work out more accurately the data we obtained, or had we adopted the method of placing a pointer over the site of the wound, from which the depth in of the foreign body can be estimated, we should have been led in the first place to have sought the foreign body in the tissues of the orbit instead of in the eyeball.

Case 1. *Presence of foreign body detected by X rays; magnet introduced into eyeball without result; eye excised; foreign body found to have passed right through globe, and afterwards detected by X rays in orbit.*—Frederick H—, æt. 19, was on November 4th, 1897, while engaged in his occupation as a blacksmith, struck in his right eye with a piece of steel which flew off the head of his hammer. He came as an out-patient to the Moorfields Hospital on November 18th, having been treated for ten days previously at another hospital, where they had recommended him to have his eye removed.

On examination a partly healed wound was seen in the sclerotic just external to the margin of the cornea at its lower and inner part. There was a notch in the margin of the lower lid at about the junction of its inner and middle thirds, overlying the scleral wound. The

cornea itself was clear, and the anterior chamber of good depth. The pupil was dilated with atropine and regularly circular. The lens was clear. With the ophthalmoscope a grey reflex was obtained from the lower part of the fundus, which was thought to be mainly due to a detachment of the retina.

Skiagraphs taken by Mr. Mackenzie Davidson showed definitely the presence of a metallic foreign body, the position of which he located in a direction posterior to the lower end of the wound in the sclerotic.

On November 22nd the wound in the sclerotic was reopened with a Beer's knife, and the terminal of a powerful electro-magnet was several times passed into the eye in the supposed direction of the foreign body, without, however, anything been found.

Three days later the eyeball was enucleated. After its removal the orbit was cursorily explored with the finger, but no foreign body was felt.

Subsequent examination of the eyeball by Mr. Marshall, the pathologist, revealed a second scar in the sclerotic, 8·5 mm. behind the anterior one and at a slightly lower level. On section of the globe this was clearly seen to be the aperture of exit of the foreign body. The apertures of entrance and exit were distant from one another in a direct line about 5 mm. There was some grey exudation in the lower part of the vitreous, but no detachment of the retina.

On November 27th another skiagraph was taken by Mr. Mackenzie Davidson, and positive evidence of the presence of a metallic foreign body again found, it being apparently in the same position as before the removal of the eyeball.

The second case is one in which unfortunately twelve days elapsed between the receipt of injury and the removal of the foreign body, during which time considerable inflammation of the uveal tract had become established. Mr. Mackenzie Davidson indicated the direction

and depth of the foreign body, and on the first introduction of the magnet it was withdrawn from the vitreous through the lens. At first the inflammation somewhat subsided, and we hoped the eye might be saved; later it again became very irritable, the tension continued *minus*, and it was ultimately excised. The case shows well that a piece of metal so small as 5 × 3 × 1 mm. can be readily detected in skiagraphs by an eye trained in examining them.

Case 2. *Position of chip of steel localised in eyeball by X rays and removed by electro-magnet.*—Fred V—, æt. 43, was on November 29th, 1897, whilst striking a rivet, hit in his left eye with a bit of metal, which he thinks came off the head of the hammer. He was admitted into the London Hospital under Mr. Tay, and a prolapsed portion of the iris was snipped off.

On December 9th he was sent to Mr. Mackenzie Davidson, who by means of the Röntgen rays was able to locate a piece of metal in the vitreous humour a little way behind the corneal scar, and a little to the temporal side.

On December 11th the patient was transferred to the Moorfields Hospital. His condition was then described by Mr. Maclennan, the senior house surgeon, as follows:

"Right eye: much conjunctival and ciliary injection; general haze of cornea and wound in the lower part, extending up to the sclero-corneal margin. Iris congested, coloboma downwards. No reflex from fundus. V. = hand movement; tension normal.

"Left eye healthy; V. = $\frac{6}{6}$."

Two days later the patient was put under an anæsthetic, the wound in the cornea was reopened with a Beer's knife, and a curved terminal attached to an electro-magnet introduced backwards and a little outwards. A piece of steel measuring 5 × 3 × 1 mm. was at once withdrawn. The eye was afterwards kept tied up with a compress, and drops containing sulphate of

atropine four grains to the ounce applied three times in twenty-four hours.

The day after the operation the anterior chamber had re-formed, and the cornea was fairly bright. There was no entanglement of iris in the wound.

The amount of injection gradually became less, and the patient left the hospital on January 4th, when the following note was made :—" Still slight injection ; cornea clear except in region of wound ; iris of good colour ; pupil does not dilate fully on account of posterior synechiæ ; opacity of lens at lower part ; red reflex obtained from inner side of fundus. V. = hand movements. Tension normal ; no pain."

Subsequently the eye became irritable and the tension *minus*.

On January 27th, 1898, it was excised.

In the third case the presence of a foreign body in the eye could not be certainly determined from the clinical appearances, but was clearly shown in the skiagraphs. Mr. Mackenzie Davidson estimated to within a millimetre its longest diameter before its removal.

The case is a good example of the advantage of being sure of the position of the foreign body before operating. On the first introduction of the magnet no result was obtained. It was introduced again in the same direction, possibly a little deeper, and at once the hold of the foreign body on the magnet was felt. Had not the position in which the foreign body lay been determined, on introducing the magnet a second time it would have been thought best to try passing it into some other part of the vitreous chamber.

In the attempt to get two clear images of the foreign body on the same plate in this case, about eight exposures, lasting from five to seven minutes each, were made. A month later the hair from the temple, which was directed nearest to the tube, fell out, leaving a large bald patch.

Case 3. *A large piece of steel diagnosed and localised in*

the eyeball by means of X rays; removed by magnet; loss of hair from temple on side exposed nearest to tube a month later.—Henry R—, æt. 24, was on December 17th, 1897, assisting in cutting a rivet, when a piece flew up and struck his left eye. He went to the Seamen's Hospital at the Royal Albert Dock, where a wound in the eyelid was stitched up and the removal of the eyeball advised.

On December 20th he was admitted into the Moorfields Hospital. Mr. Maclennan the senior house surgeon's note of his condition then was as follows:

"Right eye healthy. V. = $\frac{6}{6}$.

"Left eye: vertical cut of upper eyelid at the upper and inner part. Much conjunctival and ciliary injection. Wound of sclerotic at upper and inner part, behind ciliary region. Cornea clear. Anterior chamber of good depth. Iris slightly discoloured, of a greenish hue. Pupil regularly dilated with atropine. No reflex from fundus in the lower part; streaks of blood seen in the upper part. V. = hand movement. Tension normal."

Mr. Mackenzie Davidson, on December 22nd and 23rd, took several skiagraphs (Plate VII, fig. 2); in all eight or nine exposures to the Röntgen rays, varying from about five to seven minutes each, were made. He was able to locate a large piece of metal as situated in the posterior part of the globe, up and in, probably partly embedded in the hindermost part of the sclerotic. Its largest diameter he estimated at 1·3 cm.

On December 24th the patient was placed under an anæsthetic; the wound in the sclerotic was reopened and slightly enlarged with a Beer's knife. On the second introduction of the terminal of an electro-magnet, in the direction indicated by Mr. Davidson, the foreign body was drawn forwards; but so firmly was it fixed posteriorly that it became detached from the magnet before its removal from the eye. On a fresh introduction of the magnet it was easily withdrawn, and was found to measure 11 × 6 mm., and obliquely 12 mm.

Atropine ointment, four grains to the ounce, was applied to the eye twice a day, and iced pads for the first twelve hours after the operation.

On December 25th it was noted that there was much conjunctival and ciliary injection, some œdema about the wound, and adhesion of the palpebral conjunctiva to it. The cornea was bright and the pupil regularly dilated.

On January 7th the injection had considerably subsided, streaks of blood-clot could be seen in the vitreous. The tension was slightly *minus*, and vision = hand movement.

On January 20th, *i. e.* four weeks after the exposure to the Röntgen rays, the hair from the right temporal region extending back to an inch behind the ear fell out. There had been a slight loss of hair in this region underneath the bandage noticed a few days previously, but on the morning of January 20th a large quantity of it fell out.

In the fourth case, though we have diagnosed the presence and definitely located the position of a chip of metal in the eye by means of the Röntgen rays, it has not been felt justifiable to attempt its removal, the eye being quiet, and two and a half months having elapsed since the receipt of the injury. The size of the foreign body is estimated as less than the one removed from Case 2, measuring only 1 × 2 mm.

Case 4. *Foreign body diagnosed and localised in eyeball by X rays two and a half months after injury; eye quiet; no operation.*—Edward J. P—, æt. 37, a rigger from Portsmouth Dockyard, while hammering steel wire on October 25th, 1897, was struck in his right eye by a chip which flew off it. The eye became very much inflamed and the sight almost completely destroyed. He was treated at the Haslar Hospital for seven weeks.

On January 10th, 1898, he attended as an out-patient at the Moorfields Hospital, and the condition of his right eye was then as follows:—Eye quiet, no injection. Slight divergence. Pupil partially dilated with atropine, numer-

ous posterior synechiæ. A small vertical scar in the lower part of the cornea extending up to but not beyond its lower margin. Some ill-defined haze of the lens and a dense band of opacity in its lower part. By oblique illumination a greyish mass seen behind the lower part of the lens, which looks like a mass of fibrous tissue. By reflected light a red reflex obtained upwards and inwards, but not elsewhere. Tension slightly less than in the left eye. Vision = hand movement only, projection defective in the upper part of the field.

The following day by means of skiagraphs Mr. Mackenzie Davidson located a metallic foreign body as situated in the eye 6 mm. directly back from the wound, 2 mm. to the inner side, and 4 mm. upwards. The size of the foreign body he estimated as 1 × 2 mm. As the eye was quiet and the chip of metal probably firmly embedded in a mass of fibrous tissue, its removal was not attempted.

The fifth case, for permission to record which we are indebted to Mr. Lawford, is of special interest because the position and size of the foreign body, which was estimated in the way described, was subsequently verified at the pathological examination of the eye after its removal.

Case 5. *The size and position of a small chip of metal in eyeball estimated by X rays; subsequent excision of eye and verification of measurements.*—John E—, æt. 36, attended as an out-patient at the Moorfields Hospital under Mr. Lawford on December 29th, 1897, with the scar of a wound in the upper and inner part of the ciliary region of the right eye, a traumatic cataract, and no perception of light. He stated that two months previously the eye had been injured by a splinter which flew off the shackle pin of a cable when he struck it. The chip had not been removed or seen. For the first month after the injury the eye was red and painful; during the last month it had been free from pain. The first three

weeks he was able to see light with the eye, since then it had become quite blind.

He was sent to Mr. Mackenzie Davidson, who by means of the Röntgen rays was able to ascertain the presence of a foreign body in the eye, which he located four to five mm. directly backwards from the wound in the cornea, and estimated the size to be 1 mm. by 2 mm. On January 8th, 1898, the eye was excised. Pathological examination of it showed some dense tissue in the situation of the lens, to which the iris was firmly adherent. In this dense tissue a small piece of metal measuring 2 mm. by 1·5 mm. was found. It was situated 4 mm. behind the wound in the sclerotic. The retina was detached from the optic disc forwards.

Though it has not strictly to do with the subject of localisation, we wish to mention that we have examined three cases in which it was doubtful whether or not a foreign body had become lodged in the eye or orbit, and where by means of the X rays we were able to assure ourselves that nothing was there. We give the details of one of these cases (Case 6), which have been kindly placed at our disposal by Mr. Myddelton-Gavey, under whose care the patient was.

We think that it is in this class of cases that the use of the Röntgen rays will prove to be of the greatest practical service in ophthalmic surgery.

Case 6. *Wound of eye with a shot; absence of shot in eye or orbit determined by X rays, and confirmed by subsequent history of case.*—Police constable A. W— was on duty at a pigeon-shooting match at Tonbridge, when he received a charge of shot (No. 6 size) in the face at a distance of between sixty and seventy yards. Seeing the gun aimed at him he turned partly round, so that the shot struck his face obliquely from left to right.

One shot passed through the lower lip and remained in his mouth, another went into the skin over the right temple, and a third passed through the outer third of the

right upper lid, making what appeared to be a deep furrowed wound in the sclerotic, about one third of an inch long. This wound commenced about a quarter of an inch from the outer border of the cornea, and ran parallel with the upper border of the insertion of the tendon of the external rectus muscle.

His vision two and a half hours after the accident, when first seen by Mr. Myddelton-Gavey, was $= \frac{6}{60}$ only. No details of the fundus were then visible on account of extensive hæmorrhage into the vitreous chamber.

A skiagraph was taken by Mr. Mackenzie Davidson, in which no evidence of the presence of any shot could be detected.

About three weeks after the accident the blood in the vitreous chamber had disappeared, and the patient with a + 1 cylinder was able to see $\frac{6}{6}$.

(*January 27th*, 1898.)

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5. *Foreign body (scale of steel) in the eyeball accurately localised and measured by means of Röntgen rays.*

By Mr. L. Vernon Cargill.

(With Plate IX, fig. 1.)

A. F—, a man æt. 49, was admitted into the Royal Eye Hospital, Southwark, December 29th, 1897.

A few hours before, whilst he was stooping to hold a steel chisel which another man was striking, a fragment chipped off the head of the chisel and struck him in the left eye.

On admission there was a penetrating wound in the lower part of the cornea some 7 mm. long, passing obliquely from upwards and outwards nearly to the sclero-corneal junction downwards and inwards. Iris was entangled in and prolapsed from the wound. There was no anterior chamber. The lens was injured and becoming

opaque, and there was only a faint fundus reflex. T. — 3. He could just count fingers. Light field seemed good.

In the right eye there was a large prominent cystoid cicatrix at the sclero-corneal junction above, due to a blow with a stone when a boy. R. V. = $\frac{6}{9}$; J. 1 with + 2·00 D. sph.

The patient was, as soon as possible, placed under a general anæsthetic, and the left vitreous carefully searched with an efficient electro-magnet, but without result. Permission not having been obtained for enucleation, the prolapsed iris was abscissed, and the entangled portion freed as far as could be.

The anterior chamber had re-formed the next day, but the wound was reopened by the patient (who was an alcoholic subject) giving a sudden jerk and forcibly screwing up his lids whilst the eye was being inspected. During the next few days the patient reopened the corneal wound again by knocking his eye. There was varying ciliary injection for the next week or so. The lens became gradually more opaque, the light field less perfect, and enucleation was urged.

On February 4th Mr. Mackenzie Davidson very kindly took skiagraphs, and localised a foreign body 17 mm. behind the plane tangential to the apex of the cornea, along a line passing backwards at right angles to this plane, at the level of the lower margin of the cornea.

He estimated the foreign body to measure 5 mm. horizontally by 8 mm. vertically. Enucleation was performed on February 5th. The eyeball was hardened in 10 per cent. formol, and divided by a vertical antero-posterior section.

The outer half, mounted in glycerine jelly, shows the corneal scar to which the anterior capsule is adherent, and the iris slightly at the upper and outer angle. The lens is opaque and swollen, and the posterior capsule torn. There is irido-cyclitis with exudation and hæmorrhage into the vitreous. There is neuro-retinitis, and the retina in

PLATE IX.

Fig. 1.—Skiagraph of Scale of Steel in the Eyeball, taken by Mr. Mackenzie Davidson (Mr. L. Vernon Cargill's case) (p. 213).

Fig. 2.—Skiagraph of Chip of Steel in the Right Eye, taken by Mr. Mackenzie Davidson (Mr. Ernest Clarke's case) (p. 216).

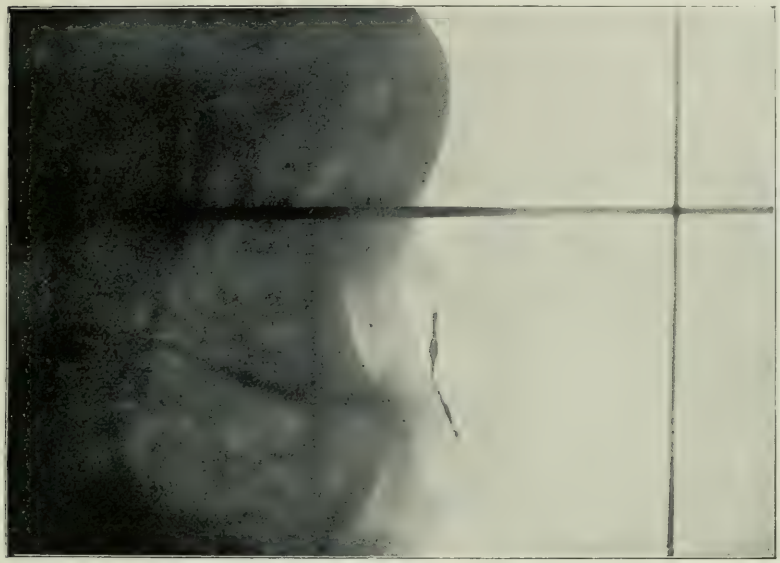

FIG. 1.

FIG. 2.

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the neighbourhood of the impacted foreign body is being dragged upon and detached in folds. A scale of steel is firmly impacted in the sclera, its posterior sharp edge bulging the superficial scleral fibres across the line of insertion of the inferior oblique muscle, and about 2 mm. in front of the posterior limit of insertion. The portion of the scale within the eyeball is surrounded by a dense inflammatory exudation, of which enough has been removed to uncover the dark anterior edge of the scale. Careful measurements show the position and size of the scale to be exactly the same as Dr. Mackenzie Davidson was led to predict, and hence this case affords further proof of the extreme value and accuracy of his method of localisation.

(*Card specimen. March 10th*, 1898.)

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6. *Small foreign body in lens located by the X rays, and subsequently removed.*

By A. Stanford Morton.

Patient was admitted into Moorfields on February 10th with the following history.

Four weeks previously he was struck in the right eye with a chip of metal while mending a boot. The piece flew off the chisel.

Radiographs were taken by Mr. Mackenzie Davidson, who localised a tiny foreign body at a position 4 mm. behind the centre of the cornea, 7 mm. above the lower border, and 2 mm. to the nasal side of the centre. This corresponded to a spot seen in the lens.

The foreign body was removed with the magnet thrust into the anterior chamber after an iridectomy had been done. The lens was left.

One week later a curette evacuation of the swollen lens was performed.

The foreign body measured 0·6 × 0·4 × 0·2 mm. in its three principal directions.

(*Card specimen. March 10th,* 1898.)

Mr. Mackenzie Davidson said he would like to refer to a very similar case to Mr. Morton's under the care of Mr. Treacher Collins. The man had been wounded in the eye last October, causing a small scar in the cornea. The lens was perfectly opaque, and there had been iritis with iritic adhesions. It became a question whether there was a foreign body in the eye. He (Mr. Davidson) located a small body in the anterior part of the lens, which he indicated. Mr. Collins did an iridectomy and put in an electro-magnet, and at once withdrew a small piece of metal, the next smallest to Mr. Morton's which he had as yet successfully located. He showed the skiagram.

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7. *Chip of steel in the right eye.*

By Ernest Clarke and Mackenzie Davidson.

(With Plate IX, fig. 2.)

Edgar J—, æt. 24, was hammering with a steel punch on November 25th, 1897, when a small chip of the punch flew up to the right eye. He was seen by several surgeons, who suspected the presence of the chip.

On February 15th last he was seen by me at the Central London Ophthalmic Hospital. The eye was quiet, and there were no signs of any inflammation. Three scars were very plain, one on the cornea, another on the anterior capsule, and the third on the posterior capsule of the lens. Little or no change has taken place in these scars, and the only change in the eye since February is that the posterior capsule, which was only just beginning to show opacity round the scar, has now become opaque over the greater part of its surface, and vision, which was $\frac{6}{12}$, is now reduced to $\frac{6}{24}$.

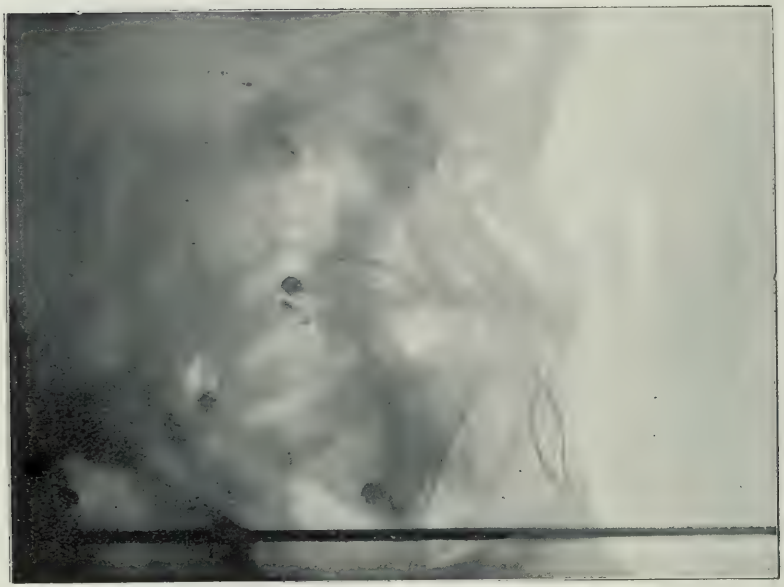

FIG. 1.

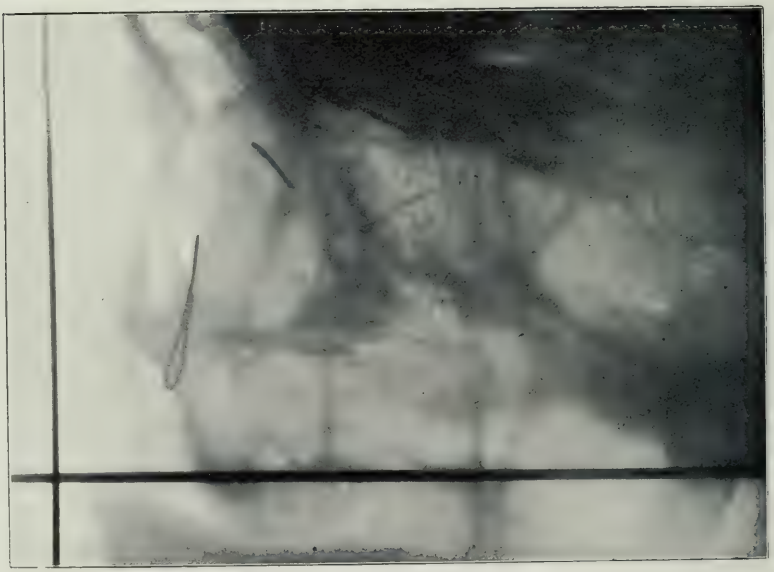

FIG. 2.

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PLATE X.

Fig. 1.—Skiagraph of Foreign Bodies in Orbit, taken by Mr. Mackenzie Davidson (Mr. Charles Wray's case) (p. 217).

Fig. 2.—Skiagraph of Foreign Body in the Vitreous, taken by Mr. Mackenzie Davidson (Mr. Simeon Snell's case) (p. 218).

Mr. Mackenzie Davidson "skiagraphed" the eye, and the following is his report:—A small spicule of steel is situated near the ciliary processes vertically below the corneal scar; it must have tumbled down after passing through the posterior capsule. The exact situation is 8 mm. vertically below, and 7·5 mm. horizontally behind, the corneal scar.

With the pupil well dilated the ophthalmoscope revealed the characteristic white patch in the above position.

The patient complains of an occasional dull aching pain at the back of the eye.

(*Card specimen. May 5th,* 1898.)

Mr. Mackenzie Davidson said that recently he had got tubes made with osmium anodes which would enable these skiagrams to be taken in ninety seconds in the case of an adult, or about a minute in a child. Very accurate and sharp shadows are obtained, because during that period the patient can keep the head and eyes perfectly still. The method of locating a foreign body in eyeballs or orbit was now so definite that anybody who cared to take the trouble could learn it.

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8. *Skiagraph of foreign bodies in orbit.*

By Charles Wray.

(With Plate X, fig. 1.)

June 9th, a charge exploded as it was being withdrawn from the muzzle of a gun. There were several wounds in the right cheek, and an abrasion of the border of the lower eyelid of the same size, about the junction of the inner and middle thirds.

The eye appeared as if it had been iridectomised upwards and outwards, and there was a pouting wound of the sclera 3 mm. from the cornea and 2—3 mm. above its horizontal meridian. There was slight hyphæma and

the vitreous contained blood, which prevented any fundus reflex being obtained. Projection was good in all parts of the visual field. T. — 1.

The skiagraph was taken by Mr. Davidson, and shows no shadow of a foreign body in the eyeball.

The shots seen at the apex of the orbit caused no paresis of muscles, and apparently did not injure the optic nerve.

August 4th.—The eyeball having shown signs of shrinking, and the tension being — 2, Mules' operation was done fourteen days ago. The wound has healed well.

During evisceration the wounds of entrance and exit from the globe were found. The retina and choroid were firmly adherent to them. On the intra-ocular aspect of the exit wound what appears like a small foreign body was found. It is less than half a millimetre in diameter, and looks like lead. Metallic or non-metallic, it is highly improbable so small a body would be skiagraphable.

(*Card specimen. June 9th,* 1898.)

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9. *Foreign body in vitreous, located by the X rays and removed by the electro-magnet.*

By Simeon Snell.

(With Plate X, fig. 2.)

James M—, æt. 31, was admitted into the Sheffield Royal Infirmary on May 7th, 1898.

Whilst chipping a piece of crucible steel fifteen weeks before admission a bit flew up and entered his left eye. He cannot tell whether the piece was from his chisel or the crucible steel, but he thinks it was from the latter. He was medically attended immediately after the accident, but he did not come to the infirmary until at least a month afterwards.

At the time of his first visit to the infirmary a fine linear scar was noticed in the cornea opposite the upper

pupillary margin ; corresponding to this the edge of iris was fixed to the capsule, and from this a broad line of opacity was traced backwards through the upper part of the lens. The vitreous was turbid, and therefore though a foreign body was diagnosed as most likely to be in the eyeball, its precise situation in the vitreous chamber was not located. The patient had only light perception, and the surface of the eyeball was much inflamed, together with iritis.

The patient was kept under observation, and with the use of atropine the iritis subsided, the surface of the globe whitened, and the vitreous cleared. In about three weeks after first seeing him the situation of the piece of steel, surrounded by lymph, was made out in the upper part of the vitreous, lying behind the opacity of the lens (this latter had not increased since his first being seen). The removal of the foreign body was suggested, and the patient consented to enter the infirmary for that purpose, but hearing of the use of the X rays in such cases, he journeyed to London for Mr. Mackenzie Davidson to take a print.

Mr. Mackenzie Davidson very kindly sent me a report of his examination, in which he says, " I got two excellent skiagrams, and localised a fragment of steel, apparently needle-shaped, in the vitreous. It is about 7 or 8 mm. in length, and is situated obliquely. It is evidently embedded in the white mass visible upwards in the vitreous."

He was after this admitted into the infirmary for the purpose of having the foreign body removed. On May 9th, after cocaine was instilled, the conjunctiva was freely separated over the globe at the lower and inner part, and after all bleeding had stopped the sclerotic was incised with a Graefe's knife. The direction of the wound was meridional, and it was joined at the lower extremity by a short cross-cut. The point of my electromagnet was introduced into the interior of the globe, and passed up to the situation in the vitreous where the foreign

body had been diagnosed as located. The fragment of metal at once became attached to the magnet, but in withdrawing the point it was peeled off at the wound, but on a re-entry of the magnet it became better attached and was at once extracted. It was, as the skiagram indicated, needle-shaped, about the thickness of a sewing-needle. It weighed 0·56 grain, and measured 9 mm. in length. The conjunctiva was united by horsehair sutures.

He was discharged on May 16th, 1898. V. = fingers, just the same as before the operation.

Difficulty is frequently experienced in deciding whether or not a foreign body is located in the interior of the globe. When a fragment is clearly visible of course the matter is readily settled, but many instances come under observation in which it is most difficult to decide, especially if the lens has been rendered opaque or some time has elapsed since the accident. The history given is frequently misleading, and in some instances the point of entrance of the foreign body, especially if through the sclerotic, is no longer distinguishable. In such instances the case related this evening indicates that the X rays are calculated to render conspicuous assistance. In the special case mentioned the situation of the splinter had of course been already made out; but Mr. Mackenzie Davidson's use of the X rays demonstrated positively that a foreign body was present in the vitreous. It confirmed the diagnosis as to its situation, and showed very clearly its size, shape, and the direction in which it lay. These points are admirably shown in Mr. Davidson's skiagram, and his measurement of the fragment corresponded very closely to its actual size as demonstrated after removal. Such a case as this, and others of Mr. Davidson's and other surgeons, indicate that the X rays have an important place in the diagnosis of foreign bodies.

(*June 9th*, 1898.)

10. *Fragment of steel removed from the retina by the electro-magnet with the retention of excellent sight.*

By Simeon Snell.

Walter G—, æt. 28, while engaged at his work on January 12th, 1898, was striking a steel-faced tool, and a small splinter flew from it and struck the right eye. He came to the Royal Infirmary on the 16th (four days later), when it was observed that the fragment had penetrated the cornea at the sclero-corneal junction on the inner side at about the median line. Beneath this corneal scar a small hole was noticed in the iris, at the periphery, and with the pupil well dilated with atropine the track of the foreign body was made out at the edge of the lens by the opacity it had occasioned. Examination with the ophthalmoscope disclosed the fragment of metal fixed in the retina in the lower and outer quadrant. The glistening of the steel was distinct, but it was surrounded and partially covered by whitish exudation. The vitreous otherwise was but little disturbed, and vision equalled about fingers.

The gravity of the case was pointed out to the patient, as well as the difficulties attendant on any attempt to remove the foreign body. After consideration, however, he decided to undergo operation for the extraction of the piece of metal. Accordingly he was admitted into the Royal Infirmary on January 19th, and on the following day (20th) the operation as now described was performed. Cocaine was instilled, and the conjunctiva was separated with scissors, and the sclerotic laid bare at the lower and inner side of the globe. All bleeding was allowed to stop, and then the sclerotic was incised (meridional incision) between the internal and inferior recti, and my electro-magnet inserted across the lower area of the vitreous to the situation of the foreign body. The point it reached was most exact, for immediately a click was

heard, but on withdrawing the electro-magnet the fragment was not attached. Again the electro-magnet was passed into the eye and the click was immediately heard, but with a like result. A careful search was made round the wound to ascertain if the splinter had been peeled off when the electro-magnet had been withdrawn, but it could not be found. A third time the electro-magnet was advanced to the situation of the foreign body; a click was again heard, and this time on withdrawing the instrument the piece of metal was found adhering to it. The exact situation of the fragment in the retina had been ascertained, but the splinter was clearly too firmly fixed either in the retina or glued by adhesions of lymph to be detached at the first two times it was brought into contact with the electro-magnet. The sclerotic wound was closed by bringing the edges of conjunctiva together by three stitches. It should be mentioned that the surface of the globe was well irrigated by perchloride solution before operation, and all the instruments were sterilised in boiling water, especially the point attached to the electro-magnet for introduction into the interior of the eye.

On January 25th he was examined with the ophthalmoscope; only a vestige of the whitish effusion in the retina at the site where the foreign body was fixed remained.

On January 29th he left the infirmary.

February 4th.—All the effusion has disappeared, but there is a large area covered with pigmentary dots.

25th.—R. V. $= \frac{6}{24}$, L. V. $= \frac{6}{6}$. The opacity in lens is unaltered.

The value of the electro-magnet for the removal of splinters of steel or iron from the interior of the eye has now become so generally recognised that the records of isolated cases or even groups of cases are hardly necessary. The instance just now related is, however, of sufficient interest to warrant its record. I have previously removed a piece of metal from the retina by

means of the electro-magnet, but the visual result was not so good as in the present instance. Galezowski,* Stevens, Meighan, and Tatham Thompson† have also reported cases in which they have removed splinters from the retina. It is, of course, well known that foreign bodies in the fundus may be tolerated with retention of vision for lengthened periods. I have myself recorded five instances, and have met with others. It would therefore appear not always advisable to attempt the removal of a splinter of iron or steel from the retina. The fixation or embedding of a fragment is always a hindrance to its extraction by the electro-magnet. In each instance the possibilities of success must be carefully weighed, and it is important that the situation of the fragment should be exactly located, so that the point of the electro-magnet be advanced immediately to it, and thereby increase the prospects of its extraction. Such a case as I have related justifies operative interference, and illustrates the gratifying results which in a well-selected case may be achieved.

(*June 9th*, 1898.)

Mr. Tatham Thompson said he had met with a similar difficulty once or twice in getting hold of a foreign body with the electro-magnet. He thought the explanation was not so much that it was embedded, but that the metal was linear, that the smallest possible aperture was made for its extraction, and that sometimes the object got crosswise across the aperture, from the contact with the magnet being at its middle. It was well then to move the magnet to one or other side, when if the magnet were attached to one end of the object it would come out readily. He thought the X rays were also of great use in excluding the presence of a foreign body in the eye. The other day a case came to him with a history that a foreign body had entered the eye, and there was a

* Quoted in my article in the 'Ophthal. Trans.,' 1886, p. 407.

† 'Lancet,' 1891, vol. ii, p. 1362.

central wound in the cornea, and the edge of the iris was bleeding. There could be seen distinct bursting of the anterior capsule of the lens, with marked traumatic cataract, so much so that it was difficult to make out the details twenty-four hours after the accident. The patient was certain the fragment had entered the eye, and was extremely anxious that he (Mr. Thompson) should try the electro-magnet, but he did not see that he could do any good thereby. He tried introducing the magnet through the corneal wound to see if there was anything in the lens substance. He did not feel justified in going any further, so he thought he would fall back upon the X rays, and with the assistance of his colleague, Mr. Lynn Thomas, he got the skiagram produced. If there had been any foreign body present he thought it would have been visible in the skiagram. No further attempt with the magnet was made ; the wound was carefully treated antiseptically, the lens substance extracted, and the man made a good recovery. There was no proof that a foreign body had entered the eye ; it was a wound of the cornea, a bursting of the lens by the concussion, but the body evidently flew off.

Mr. Snell, in reply, thought the X rays more useful in detecting a foreign body than proving its absence, because it seemed to him to require a skilled operator to use them very successfully.

X. OPERATIONS.

1. *Right congenital ptosis treated by Mules' operation.*

By W. J. Cant.

B. W—, æt. 8. *Right eye.*—V. = $\frac{6}{24}$; congenital ptosis. He was only able just to separate the lids, and could not expose the cornea by muscular effort (Fig. 28). The superior rectus muscle had only slight power; other muscles normal.

Left eye.—Normal. V. = $\frac{6}{6}$.

September 27th, 1897.—Operation on right eyelid. A permanent subcutaneous wire loop was introduced, connecting the tendon of the frontalis muscle above the brow with the lower edge of the tarsal cartilage, and so putting the lid under the control of the occipito-frontalis muscle (described by Mr. Mules in the 'Trans. Eighth International Ophthal. Congress,' p. 57). Every antiseptic precaution was taken during the operation. There was only slight reaction. On examination, eight weeks after, the eyelid could be raised so as to expose the whole cornea and closed without any difficulty (Fig. 29); the vision of the right eye had improved to $\frac{6}{18}$, and the superior rectus muscle had gained some power.

(*Card specimen. December 9th,* 1897.)

P.S. June, 1898.—The condition of the right upper lid is as good as in December last, and the patient seems able to raise the lid without effort.

FIG. 28.

Before operation.

FIG. 29.

After operation.

Photo. by Dr. Daman.

2. *Mules' operation for ptosis.*

By A. Stanford Morton.

Jane H—, æt. 46, first noticed the right upper lid drooping twenty years ago. She suffered much at that time from facial neuralgia on the right side. Since then, and especially during the last two years, the drooping has become much worse. The left upper lid has only been affected three years. When first seen the right palpebral aperture was only capable of being opened for about a fourth of the usual amount, and the left for about half. The movements of the eyeball were much restricted in all directions. It was decided to operate by introducing, and leaving, a silver wire in each upper lid, somewhat after the method described by Mules in the 'Trans. of the Internat. Ophthal. Congress' at Edinburgh in 1894.

On October 10th, 1897, the right lid was operated on, but the lower incision was made a short distance above the ciliary border instead of in the free edge. The wire was passed from this incision to above the eyebrow, where the twisted ends were embedded in another small incision.

On November 12th the left lid was operated on. The lower incision was made, rather less than half an inch long, in the cartilage at the free margin of the lid, and the needles threaded with wire were entered one at either extremity of this incision, and carried up to above the eyebrow. The adjustment of the lid and fastening of the wire were left until the next day, when the patient had recovered from the anæsthetic. The movements of the lid were perfect, and the photograph, taken about six weeks after the operation, shows the patient forcibly raising the lids.

(*Card specimen. December 9th*, 1897.)

P.S. June, 1898.—Patient has not been seen since January, 1898.

3. *Conical cornea, and the effects of treatment by the galvano-cautery.*

By Anderson Critchett.

J. G—, æt. 21, a maid-servant, first became aware that her sight was failing three years ago. The left eye was the worse, though both appeared to fail simultaneously, and rather suddenly. Two or three months previous to the failure of sight she was laid up in bed for three days, suffering from anæmia. She had had at that time several fainting fits, but beyond this had had no serious illness throughout her life. She is at the present time an anæmic girl, always troubled with headache, worse after meals, and after exertion has shortness of breath, &c.

Last November she came under my care with well-marked conical cornea in each eye.

R. V. = $\frac{6}{60}$, J. 4 slowly at 10 cm. Conical cornea, eccentric cone.

L. V. = $\frac{6}{60}$, J. 12 at 10 cm. Conical cornea, central cone.

Neither eye materially improved by spheres or cylinders.

In November I cauterised the cone in her right eye, but stopped short of perforation.

Subsequently, in February this year, I performed the same operation on her left eye.

Present condition.—

R. V. = $\frac{6}{9}$ 2 letters, and J. 1 at 20 cm. Not improved by lenses.

L. V. = $\frac{6}{60}$, J. 10 at 15 cm.

Under Homat. $\begin{cases} \bar{c} + 2 \text{ D. sph.} = \frac{6}{24}. \\ \bar{c} + 3 \text{ D. sph.} = \text{J. 4 at 15 cm.} \end{cases}$

Owing to the eccentric position of the scar caused by the cautery the vision in the R. E. is good without mydriasis, and so does not demand an iridectomy. In

the L. E. the leucoma is central, so the vision is only improved if the pupil is dilated, hence in this eye an optical iridectomy should prove of great value.

Operation.—My mode of procedure is as follows :—I first of all cauterise the cone over an area to which I intend to limit my scar with the point of the galvano-cautery at a black heat. Within this area I destroy a little more at a slightly increased heat, and within this second zone I finally burn deeper with the point at a dull maroon red heat, stopping short of perforation. I have thus three zones, and at the conclusion of the operation, as I have on former occasions mentioned, the centre of the cornea is concave, not from destruction of tissue, but from the shrinking of the cornea, the surface of which often, if not invariably, exhibits fine radial wrinkles, rhytidosis corneæ.

(*Card specimen. May 5th*, 1898.)

Mr. Doyne thought it would be well to leave for some time the iridectomy in the other eye. He (Mr. Doyne) had operated on a boy three times, *i. e.* cauterised his cornea, and showed him to the Society eight years afterwards. He would not say that at that time the nebula could not be seen, but on casual inspection it would not be noticed. He asked whether Mr. Critchett meant that the aqueous so disappeared that the cornea was in contact with the lens. If so, surely it would be dangerous to apply heat so close. He would like to try the procedure, but would be afraid of getting too near to Descemet's membrane.

Mr. Hartridge asked what was the object of using the cautery at three different temperatures. He had done many such operations, and had simply kept the cautery at a dull red heat. He had never seen the aqueous disappear, and would be glad to hear the author's explanation. Mr. Critchett had said it disappeared although there was no perforation of the cornea. He did not know where the aqueous could have gone to.

Mr. John Griffith said he had seen the disappearance of the aqueous humour from the anterior chamber after cauterisation, so that the eye resembled the appearance seen in ordinary chronic glaucoma.

Mr. Marcus Gunn did not quite understand whether what they saw was the outer ring that was first made with the lowest heat. He would like to know how far out beyond the apex of the cone Mr. Critchett went in his first cauterisation. For many years past he (Mr. Gunn) had been in the habit of operating with the galvano-cautery for conical cornea. He did not attack the centre, but about 2 mm. away from it below in a semicircle, so as to avoid interfering with central vision. In that way he had got moderately successful results, but he did not think he ever saw anything so satisfactory as $\frac{6}{9}$ produced by one operation of this kind, though he had seen great improvement.

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4. *Plastic operation for contracted eye socket.*

By F. R. Cross.

Alice S—, æt. 14, came complaining that she could no longer wear her glass eye.

When the child was five years old her right eye was enucleated for a wound inflicted with a chisel. A glass eye was worn for two or three years, but then caused inflammation of the socket, and was discontinued. No false eye has been worn for the past six years.

When seen in January last the right eyelids appeared to be atrophied and flattened, the palpebral aperture was narrowed. There was no conjunctival part to the socket, which consisted merely of the tarsal portions of the lids, which could barely be separated from one another.

No fornix existed to the lower lid, while that of the upper lid extended for about $\frac{1}{4}$ of an inch only. The slit-like socket was quite free from pain and inflammation.

May 26th, 1898.—A plastic operation to make a new socket by means of a flap of skin from the temple was undertaken.

1. The external canthus was divided.

2. A flap of skin was dissected outwards and a little downwards, with a pedicle left attached to the outer part of the upper lid.

3. A horizontal incision was made through the conjunctiva from inner to outer canthus, going deeply into the subconjunctival tissue, which was contracted and fibrous.

4. The cut edges of the conjunctiva were freely dissected apart, thus separating the upper from the lower lid, and making as large a raw surface as possible between them in the depth of the orbit.

5. The flap of skin was twisted on its pedicle, its raw surface was pushed down into the orbit between the lids, and the edges of the conjunctiva lining the upper and lower lids were sutured to its free margins.

6. The wound on the temple was brought together by sutures of silver wire and catgut.

On the day following the operation there was a good deal of swelling; but on the fifth day the lids could be opened so as to allow the socket, formed anteriorly by the conjunctiva of the lids, posteriorly by the skin flap, to be well washed out. The wire sutures on the temple were removed.

Three weeks after the operation a small shell could be retained in the socket, and a fortnight later the shell was well borne, while a fair-sized false eye could be retained.

The patient is shown on the forty-third day after the operation. A good-sized glass eye is well retained. The skin flap has scarcely altered in appearance, but is in

spots unusually pink. A disfiguring scar remains on the temple, but is getting less marked.

(*Card specimen. July 8th*, 1898.)

The PRESIDENT said Mr. Cross was to be congratulated on the success of the procedure, and none the less so because the mode of operation was simple; indeed, the more complicated a procedure was, the more difficult it was to be thankful for it. In his experience, transplantation of mucous membrane in these cases was useless, for the submucous tissue went on shrinking, but Mr. Cross's method neutralised that shrinkage.

Dr. REEVE (Canada) said the only operation which he had done similar to this was where the space was so small that an artificial eye could not be worn. He dissected the conjunctiva away from the globe, and left a large central area, upon which he put a flap of skin, and stitched it carefully at the edges. This united and furnished a good-sized space for an artificial eye.

In answer to the President, Dr. Reeve said another operation was that presented by Dr. G. C. Harlan, President of the American Ophthalmological Society, at its last annual meeting. He made a circular incision into the tissues of the orbit, and implanted a lead wire ring, and then allowed the tissues to cicatrise over. This was left in long enough to form a permanent cicatricial bed. Then he cut down upon the ring and put in a thin leaden artificial eye for a time, and afterwards an ordinary artificial eye, with perforations through it to allow of the escape of any discharge. He had published a photograph of the case, and the result seemed quite satisfactory.

5. *Report of a committee of the Ophthalmological Society appointed in March,* 1896, *to consider the relative value of simple excision of the eyeball, and the operations which have been substituted for it.*

The committee has collected evidence respecting the following operations:

1. Simple excision of the eyeball from Tenon's capsule, the tendons of the muscles being cut close to the globe.
2. Evisceration with or without the insertion of an artificial globe into the emptied sclerotic.
3. The insertion of an artificial globe into Tenon's capsule after the removal of the eyeball.
4. Abscision.
5. Optico-ciliary neurotomy.
6. Optico-ciliary neurectomy.

Historical Notes.

The first recorded case of extirpation of the eye we have been able to find was performed by Bartisch* in 1583 by means of a spoon with cutting edges. This spoon was forced into the orbit, and the whole contents of the orbit scooped out.

In 1596 the "inconveniences" of this spoon were recognised by Hildanus, who invented a "slightly curved knife with blunt extremity."

A hundred years later the cutting spoon was still in use, but Bartolin † mentions a case where, in preference to its use, "a cancerous eye was torn out by hooks."

Later, Louis ‡ advocated, in addition to a knife, the use of scissors and hooked forceps.

* 'Extirpation de l'œil,' 1583.

† 'Operative Surgery of the Eye,' Guthrie, 1823.

‡ 'Diseases of the Eye,' Rowley, 1790.

For the first forty years of the present century the operation for removal of the eyeball, or the operation of extirpation, as it was termed, and which was only done in cases of "fungus hæmatodes," was performed as follows:

The outer canthus was first divided, a large curved needle armed with a thick waxed thread was passed through the eyeball, the needle removed, and the thread knotted. By means of this thread the globe could be drawn in any direction that was required during the remaining stages of the operation. A double-edged curved scalpel was next plunged backwards into the orbit at the inner canthus, and by carrying the instrument round the eyeball the structures connecting it with the walls of the orbit were divided.

Finally the optic nerve, the recti, and superior oblique muscles were cut through at the apex of the orbit. Considerable hæmorrhage usually occurred, which was controlled by the injection of cold water or by pressure. Owing to the severity of this operation, especially in pre-anæsthetic days, it was very rarely performed, and in the ten years 1839 to 1848, out of 1419 operations at the Royal London Ophthalmic Hospital, Moorfields, it was performed only four times, although during this period there attended at the hospital 2302 cases of injury, 24 cases of "fungus of the globe," and 16 cases of "tumours of the orbit."*

1. *Simple excision of the eyeball.*—In 1841 J. M. Ferrall † in Dublin, and Bonnet ‡ in France, independently proposed removal of the eyeball from within Tenon's capsule, with division of the tendons close to the globe.

In 1842 this operation was first put into practice by Stoeber, § of Strasburg.

* 'Operation on Eye,' Bowman, 1849, pp. 142, 143.

† 'Dublin Medical Journal,' 1841.

‡ 'Traité des sections tendineuses et musculaires,' 1841, pp. 321—323.

§ 'Annales d'oculistique,' t. vii, 1842, p. 31.

In 1844 Ferrall * performed the operation himself for the relief of pain in a case of orbital tumour. This was not only the first excision in the United Kingdom, but, according to his statement, the first time the eyeball had been removed for a non-malignant condition.

In 1851 George Critchett, † unaware of what had already been done, suggested and performed this operation in a case of intra-ocular tumour at the Royal London Ophthalmic Hospital, Moorfields.

Previous to this date the operations in general use for painful blind eyes were simple incision—so-called "sinking of the globe,"—in which a portion of the cornea was cut off, and a poultice applied; abscision, deligation or strangulation of a staphylomatous cornea by a double ligature, and the slicing off a fungous growth with application of nitrate of silver to the stump.

In 1850 Pritchard, ‡ of Bristol, performed for the first time extirpation of an injured blind eye, and noticed the immediate cessation of sympathetic symptoms. He subsequently advocated extirpation in all cases of sympathetic disease.

2. *Evisceration.* — In 1874 Noyes § published what appears to be the first account of the operation of evisceration. He performed the operation in cases of suppuration of the eye, obtained a good cosmetic effect, and met with no subsequent sympathetic trouble.

In 1884 Alfred Graefe, ‖ of Halle, began to practise evisceration for the purpose of avoiding the risk of purulent meningitis, a catastrophe which had occurred in two of his cases after removal of the globe for panophthalmitis. He held it to be a safer procedure,

* 'Dublin Hospital Gazette,' 1846, vol. ii, p. 194.

† 'Lancet,' 1854, i, p. 243; ibid., 1855, ii, p. 464.

‡ 'Provincial Med. and Surg. Journal,' 1851.

§ 'Trans. Fourth International Ophthal. Congress,' p. 27.

‖ 'Vortag gehalten in der natur forscher Versammlung zu Magdeburg,' 1884.

on the ground that it did not establish an open communication between wound and brain.

In the same year Mules * performed evisceration for the prevention of sympathetic ophthalmitis, at the same time introducing a hollow glass sphere into the cavity of the denuded sclerotic.

3. *Excision and insertion of globe into Tenon's capsule.*—In 1886 Adams Frost † suggested the insertion of a glass globe into Tenon's capsule after excision. This operation has been extensively practised by Lang ‡ (see Appendix).

4. *Abscision.*—Partial ablation or abscision is an operation of very ancient date; it was introduced by Celsus, § subsequently practised by Scarpa, and at a much later period by Beer and Guthrie.

In 1863 the late George Critchett || published 'An Improved Surgical Method for treating Total Anterior Staphyloma of the Cornea.'

The main feature of his operation was closure of the cavity left after removal of the cornea by several interrupted sutures. A single suture had been previously adopted by Wilde ¶ in 1847.

The introduction of sutures into the conjunctiva only, instead of through sclera and ciliary body, was subsequently proposed by Knapp.**

5. *Optic ciliary neurotomy.*—In 1857 v. Graefe †† suggested division of the optic nerve as a preventive against sympathetic inflammation, but as the theory of transmission by the optic nerves was soon afterwards abandoned, the suggestion was not then put into practice.

* 'Trans. Ophth. Soc.,' vol. v, p. 200.
† Middlemore Prize Essay, British Medical Association, 1886.
‡ 'Trans. Ophth. Soc.,' vol. vii, p. 286.
§ 'Celsus de Re Medicâ,' lib. vii, pars 2, cap. i, sect. 2.
|| 'R. L. Ophthal. Hosp. Reports,' vol. iv, p. 1.
¶ 'Dublin Quarterly Journ. of Med. Science,' 1847.
** 'Archiv für Ophth.,' Bd. xiv, Ab. 1, S. 275, 1868.
†† Ibid., Bd. iii, S. 454.

In 1866* the same author suggested division of the ciliary nerves within the eye for the relief of pain and tenderness in blind eyes.

Ed. Meyer † published an account of twenty-two cases in which he had practised this operation with satisfactory results.

In 1866 Rondeau ‡ divided the optic and ciliary nerves in animals and in the dead subject, but does not appear to have put the operation into actual practice.

Landesberg § seems to have been the first to divide the optic and ciliary nerves in a patient for the relief of pain.

In 1873 Snellen ‖ divided the ciliary nerves behind the globe, leaving the optic nerve intact.

6. *Optico-ciliary Neurectomy.*—The substitution of neurectomy for neurotomy appears to have been introduced by Schweigger ¶ in 1885, and to have been extensively practised by him.

In the following pages the committee have endeavoured to answer *seriatim* the questions submitted by them to the Society in the circular of May, 1896.

I. What are the Relative Risks of Meningitis?

The first point to determine in connection with this question is the frequency of meningitis after simple excision. The largest number of cases of which we have been able to obtain details are those from the Moorfields Hospital, which have been collected for us by C. D. Marshall and E. C. Fischer.

They found that between the years 1861 and 1896 there were 6876 cases of excision. Prior to 1882 there was no fatal case from meningitis, but since then seven

* 'Archiv für Ophth.,' Bd. xii, Ab. ii, S. 149.

† 'Annales d'Ocul.,' 1867, t. lviii, p. 129.

‡ 'Des affections oculaires reflexes et de l'ophtalmie sympathetique,' 1866.

§ 'Archiv für Ophth.,' Bd. xv, Ab. 1, 1869.

‖ Ibid., Bd. xix, Ab. 1, S. 257.

¶ 'Archives of Ophth.,' vol. xiv, p. 223.

fatal cases have occurred, or 0·1018 per cent. of the total number of excisions since 1861.

The following table shows the number of excisions and the number of cases fatal from meningitis during quinquennial periods since 1861.

Date.	No. of Excisions.	No. of fatal Meningitis cases.
1861–65 ...	360 ...	0
1866–70 ...	484 ...	0
1871–75 ...	845 ...	0
1876–80 ...	601 ...	0
1881–85 ...	1392 ...	2
1886–90 ...	1312 ...	2
1891–95 ...	1586 ...	2
1896 ...	296 ...	1
Total ...	6876 ...	7

Other figures dealing with a smaller number of cases are quoted by Noyes* as follows:

"At the Vienna Ophthalmic Clinic, Arlt reported 1000 enucleations done by himself and his assistants with no death.

"In Dr. Knapp's Clinic, d'Oench and Andrews report 578 cases with no death; of these cases thirty-two were suppurative. To augment the material from which a judgment may be formed, I have examined the reports of the operations done during twenty years at the New York Eye and Ear Infirmary, viz. from 1868 to 1888. There were 1164, and of these 161 had suppurative panophthalmitis; add to these seventeen cases of suppuration of the globe, for which evisceration was done. There has been no death in the whole series."

At the Royal Westminster Ophthalmic Hospital from the year 1887 to 1896 there were 190 cases of excision, and no fatal case of meningitis amongst them.

At the Central London Ophthalmic Hospital from 1887 to 1896 there were 137 cases of excision, and no fatal case of meningitis. At the Leeds General Infirmary during the three years ending December, 1895, A. L. Whitehead

* 'Trans. of the American Ophthal. Soc.,' vol. v, p. 315.

informs us there were 221 cases of excision and no case of meningitis.

Schulek informs us that at the University Ophthalmic Hospital, Buda Pest, from 1874 to 1896 there were 568 cases of excision, and no fatal case of meningitis amongst them.

The comparison of these other figures with those from Moorfields Hospital shows that the death-rate there from meningitis after excision has during the last sixteen years been exceptionally high.

If we add all the figures from these different sources together we get the following result:

	No. of cases.	Fatal Meningitis cases.
R. L. O. Hospital...	6876	... 7
R. W. O. „	190	... 0
C. L. O. „	137	... 0
Vienna Arlt	1000	... 0
Knapp's Clinic	578	... 0
New York Eye and Ear Infirmary	1164	... 0
Leeds General Infirmary... ...	221	... 0
University Ophthalmic Hospital, Buda Pest	568	... 0
Total ...	10,734	... 7

In considering this subject it must be borne in mind that meningitis may arise independently of excision, from suppuration in the eye. Cases* proving this have been recorded by Warlomot, Knapp, and Tay.

The following case, to which we have been referred by J. W. Barrett of Melbourne,† is one which he says is a definite instance of meningitis existing at the time of excision quite unsuspected for at least twenty-four hours after operation, and evidently independent of it.

A man æt. 34 received a blow on his left eye from a splinter of wood; much pain followed, which by the

* Quoted by Nettleship in his paper on "Meningitis after Excision of the Eye," in the 'Transactions' of this Society, vol. vi, pp. 458, 459.

† 'Intercolonial Med. Journ. of Australia,' July, 1896.

evening had become intense; the lids were then swollen and vision abolished. The symptoms increased the next day, and the patient vomited. He vomited again the third day, and complained of headache. The fourth day he was worse. The fifth day he was admitted. The eyelids were then intensely swollen; the temperature was 99·4°, and the patient quite sensible.

The eyeball was excised, found completely disorganised and containing pus. The orbit was irrigated with perchloride of mercury 1 in 2000. Temperature after operation 99·8°.

The next morning the patient was better, but in the evening he became delirious. Temp. 102·8°. The second day after the operation and the seventh after the injury he died.

At the post-mortem, lymph was found about the base of the brain; the condition of the orbital plate of the frontal bone suggested a mode of entry of septic matter. The meningitis must have been of at least three days' duration, since some of the lymph was organised and the adhesions firm.

There can be no doubt that meningitis may be set up by the operation of excision, but it is highly probable that, in a certain proportion of the cases in which patients have died from meningitis after excision of a suppurating eye, the meningitis began before the operation, and that the patient would have died from it had no operation been performed.

We come now to the question whether excision is more liable to be followed by meningitis in any special class of cases than in others.

It was laid down by Graefe many years ago * that the excision of suppurating eyes should be avoided on the ground that meningitis was likely to follow.

Nettleship, in the paper before referred to, collected the records of thirty cases of meningitis after excision; in twenty-seven of these the state of the eye at the time

* Zehender's 'Klin. Monatsbl. f. Augenheilk.,' 1863, Bd. i, s. 456.

of excision was mentioned, and "in just one half of these, or fourteen cases, there was one stage or another of suppurative panophthalmitis, often recent, occasionally of several weeks' standing."

In all the seven cases which occurred at Moorfields Hospital since 1861 the eyeball excised was affected with a suppurative inflammation. Or, to put it in another way, out of 6876 cases of excision performed at the Moorfields Hospital there has not been a single death from meningitis following the removal of a non-suppurating eye. The same may also be said of the 10,734 cases which we have collected from various sources.

We have not received notes or found records of any case of death from meningitis after the operations of abscision, optico-ciliary neurotomy or neurectomy, evisceration with the insertion of an artificial globe into the sclerotic, or after excision with the insertion of an artificial globe into Tenon's capsule.

Yet, seeing that meningitis after excision is such an exceedingly rare event, it may be that sufficient experience of these operations has not yet been obtained to permit of it being definitely stated that they are less prone than excision to be followed by meningitis.

It seems probable that neither optico-ciliary neurotomy, optico-ciliary neurectomy, Mules' operation, nor the insertion of a glass globe into Tenon's capsule after excision have any of them been performed more than 1000 times.

Wolkomitch collected 768 recorded cases of evisceration, including some of Mules' operation, in none of which had there been any meningitis.

Fuchs * and Otto Becker † both refer to two cases of Schulek's in which death followed during the first week after what is said to be evisceration. We have communicated with Schulek respecting them, and he informs us that they were both cases of exenteration of the orbit for malignant growth, and that the meningitis of which they

* 'Text-book of Ophth.,' English translation of 2nd edition, p. 322.

† Nagel, 1888, p. 118.

died was due to extension of the growth into the cranial cavity.

Bocci * has recorded a case of purulent infiltration of the cornea, which in a short time passed on into panophthalmitis, and in which death followed five days after evisceration of the eyeball, from cerebro-spinal meningitis. Blood and various tissues removed from the body showed that the cause of the disease was the Fraenkel pneumococcus.

II. What are the Relative Risks of Sympathetic Inflammation?

In dealing with this question two separate points present themselves for consideration:

1st. Is it possible that any of the operations themselves should start sympathetic inflammation?

2nd. What is the relative value of these different operations in preventing sympathetic inflammation when performed on eyes with lesions which would be likely to excite it?

A committee of this Society on sympathetic ophthalmitis reported: † "We found thirty cases in which genuine sympathetic ophthalmitis set in after excision, and six others the sympathetic nature of which is doubtful." In considering this group of cases they discussed whether the sympathetic disease was excited by the injured eye, or by the operation for its removal. They pointed out that if the disease were due to the excision, we should expect to meet occasionally with cases in which the disease in the second eye came on a long time after the operation, and sometimes after removal of eyes which otherwise would not have been likely to produce sympathetic mischief.‡

* 'Arch. di Ottal.,' Palermo, 1896–7, iv, 104.

† 'Trans. Ophth. Soc.,' vol. vi, p. 189.

‡ Ibid., p. 191.

They quote four cases in which a long interval elapsed between the excision and the onset of the disease in the other eye, to only two of which they do not see that any exception can be taken, unless it be assumed that the disease in the second eye was spontaneous.

They only found one case in which the disease came on after the removal of an eye which would not have been likely to cause sympathetic ophthalmitis, and that was a case in which the first eye was lost by spontaneous inflammation.

We have not found a record of any case of sympathetic ophthalmitis following evisceration without the insertion of an artificial globe (Graefe's operation).

We have collected records of five cases of sympathetic ophthalmitis after the operation of evisceration and the introduction of an artificial globe into the emptied sclerotic (Mules' operation).

The first two cases are recorded by F. R. Cross.*

Case 1.— A man æt. 40 received a transverse wound of the left eyeball three lines above the corneo-scleral junction, through which there was a slight protrusion of the uveal tract. When first seen the iris was inflamed; the lens appeared to have escaped injury. Seventeen days after the injury Mules' operation was performed with strict antiseptic precautions. The right eye at that time was noted as good. The reaction after the operation appears to have been considerable but not excessive. As the swelling of the conjunctiva subsided the glass ball was seen exposed through a small fistula.

Seventeen days after operation and thirty-four days subsequent to the original injury the patient first noticed slight discomfort in his right eye. When seen two days later there was found ciliary injection, a discoloured iris, and an irregular pupil. He complained of pain, and his vision was reduced to J. 16.

The artificial globe was then removed, and the right

* 'Trans. Ophth. Soc.,' vol. vii.

eye was treated with atropine and a black bandage. At the end of about three months he had completely recovered. His vision was = $\frac{5}{5}$ and J. 1, and his pupil was regular and active. There is no note as to other possible causes of the iritis.

Case 2.—A man æt. 50 received an injury to his right eye from a twig of gorse, which was followed by inflammation and pain. When he was first seen two weeks later the cornea was scarred and opaque, and there was a small prolapse of iris in the centre. Three months after the accident Mules' operation was performed, a silver globe being introduced under antiseptic precautions. The left eye at that time was in every respect in good condition. Chemosis and swelling of the lids followed the operation; twelve days after it, the metal globe, which was exposed through a fistula, was removed.

Three weeks after the operation, when the patient left the hospital and was exposed to the sunlight for an hour or so, the sight of his left eye became misty.

When seen eight weeks after the operation there was distinct papillitis, with inflammation of retina and slight iritis. Vision was reduced to $\frac{2}{4}\frac{0}{0}$ and J. 4.

In the right orbit a small fungous prominence showed that the button of contracted sclera was still discharging. He gradually improved under treatment, and ultimately was able to see $\frac{2}{4}\frac{0}{0}$ and J. 1, the pupil becoming active and regular, and the media clearing, except for a few spots on the lens. There is no note as to other possible causes of the iritis.

The notes of the third case have been sent to us by W. Charnley, of Shrewsbury.

Case 3.—J. E—, a young man of about 25, was admitted into the Eye Hospital, Shrewsbury, on September 23rd, 1896, having been wounded the previous day in the right eye by a stone.

The wound was an irregular one, extending about half-

way across the cornea, and into the sclera for about the same distance. He was kept in the hospital.

By October 10th the wound had healed.

On October 29th, as the eye was still irritable and blind, Charnley performed Mules' operation in the usual way.

On November 15th he complained of the left eye running and being a little red. Two days after these symptoms had disappeared.

On November 25th the left eye was again a little red, and on examination with the ophthalmoscope the usual punctate deposit was found on the posterior surface of the cornea. Charnley says there could be no doubt of the sympathetic nature of the affection.

The inflammation ran a protracted course, but ended more favorably than was expected. He recovered with V. $= \frac{6}{18}$. The result of the Mules' operation was most satisfactory. He quickly recovered from it, and obtained a capital stump, which was not at all irritable or painful during the course of the inflammation in the other eye.

The fourth case was communicated to this Society by F. R. Cross in June, 1897.

Case 4.—A boy æt. 15 received a perforating wound in the outer sclero-corneal region of his left eye, implicating the iris and lens.

Three weeks later evisceration was performed and a small glass globe introduced into the sclerotic. Considerable chemosis and œdema followed. The patient left the hospital fourteen days after the operation, apparently quite well.

Thirty-five days after the operation he returned with irido-cyclitis in the right eye. V. $= \frac{5}{60}$, J. 10.

He stated that the right eye became uncomfortable a day or two after leaving the hospital; the sight soon became hazy. The stump of the eviscerated eyeball was excised, and under treatment the right eye gradually recovered.

Ten months after the operation the eye was quiet, media clear. V. = $\frac{5}{6}$ and J. 1.

The notes of the fifth case have been sent to us by Bickerton of Liverpool.

Case 5.—A man æt. 45 received a perforating wound of his eye from a fragment of steel which remained in it. Twenty-one days after the injury Mules' operation was performed. The patient left the hospital on the eleventh day.

He returned twenty-one days later with sympathetic inflammation, there being a complete ring of synechiæ and some ciliary injection. He stated that he had had a cold in the eye for a week. Thus sympathetic inflammation commenced forty-six days after the injury and twenty-five days after the operation. Under treatment the synechiæ gave way, and V. = $\frac{6}{5}$ was restored at the end of a week.

It will be noticed that in each of these cases the eye upon which the operation of evisceration was performed had received a perforating wound such as would be likely to excite sympathetic mischief.

We have no notes of any case in which the second eye became inflamed after the operation of evisceration had been performed for an affection unlikely to produce sympathetic disease.

The time which elapsed between the receipt of injury and the onset of the sympathetic trouble was as follows:

Case 1, five weeks; Case 2, four months; Case 3, six weeks; Case 4, about six weeks; Case 5, six and a half weeks: therefore the sympathetic inflammation might well in each case be attributed to the injury. If, on the other hand, the sympathetic inflammation be considered the direct outcome of the operation itself, the interval between the lesion and the onset of the trouble in the other eye would be unusually short, namely, in Case 1, seventeen days; Case 2, three weeks; Case 3, seventeen days;

Case 4, less than three weeks; and Case 5, twenty-five days. Not so short, however, as to make it impossible to regard the operation as the exciting cause.

Whether evisceration is as efficacious in the prevention of sympathetic ophthalmitis as excision can only be definitely determined by statistics gathered from a larger number of cases than we have been able to collect.

Anderson Critchett, Argyll Robertson, and Nettleship, at the June meeting of 1897 * of this Society, all bore witness to the extremely low percentage of cases of sympathetic inflammation after excision.

It has been ascertained that at the Moorfields Hospital from 1892 to 1896 inclusive there were 1596 eyes excised, and in only one of these cases is it known that sympathetic inflammation subsequently developed. Granting that Mules' operation has now been performed 1000 times, which so far as we can ascertain seems a fair estimate, we have, it will be seen, been able to collect five cases in which inflammation, believed to be sympathetic, followed.

Mules was led to adopt evisceration as an operation for the prevention of sympathetic inflammation on the assumption that the disease was set up by infecting particles travelling from a septic uveitis in the exciting eye. He argued that removal of the contents of the globe under aseptic conditions, before infecting particles of the uveitis had begun to travel, ought to prevent sympathetic ophthalmitis.

Assuming the theory that the transmission of some morbid substance from one eye to the other is the cause of sympathetic inflammation to be true, the only way of explaining the occurrence of sympathetic ophthalmitis after excision is to regard the morbid substance as having passed the point at which the structure or structures by which it travels were divided at the time of the operation.

The clinical fact that the interval between the excision

* 'Trans. Ophth. Soc.,' vol. xvii.

and appearance of sympathetic ophthalmitis is very short is in keeping with this view.

In evisceration, though the source of the morbid substance, viz. the uveal tract, may be entirely removed, the track by which it travels is not divided so far back as in excision. So that if this theory of sympathetic inflammation we started with be correct, we should expect to find that in cases in which more than two weeks had elapsed between the receipt of the wound and the operation, there would be a larger percentage in which sympathetic ophthalmitis came on after evisceration than after excision.

The committee of this Society on sympathetic ophthalmitis, in discussing the length of interval between the lesion of the exciting eye and the earliest appearance of sympathetic inflammation, say they have found eighteen genuine cases in which the interval was not more than four weeks. "In six of these the interval was four weeks; in six, three weeks; in two, between two and three weeks; whilst in only four was it two weeks or less."

In the cases above quoted the interval between the operation of evisceration and the onset of the symptoms in the second eye, was not longer than that which has been recorded as existing between the excision of the eye and the onset of undoubted sympathetic ophthalmia in the other.* It is noteworthy, moreover, that in all these five cases in which sympathetic ophthalmitis followed on evisceration, the sympathising eye ultimately recovered completely, as is usually the case when sympathetic disease occurs after excision.†

We have received notes of two cases in which sympathetic ophthalmitis occurred after excision and the introduction of a glass globe into Tenon's capsule; one from Cant of Lincoln, and the other operated on by Lang at Moorfields.

* *Vide* 'Trans. Ophth. Soc.,' vol. vi, p. 192.

† *Vide* Nettleship, 'Clin. Soc. Trans.,' vol. xiii, 1880, and 'Trans. Ophth. Soc.,' vol. vi, p. 189.

Cant's Case.—A man æt. 30 received an injury to one eye in the outer ciliary region from a chip of steel on March 12th, 1897. An unsuccessful attempt was made to remove the chip of steel thought to be in the eye with the electro-magnet on March 22nd. Excision was then advised, but the patient would not consent until April 11th. The eyeball was then removed and a glass globe inserted into Tenon's capsule with all antiseptic precautions, the patient's other eye at that time being quite strong and healthy. A piece of metal was found in the excised eye.

Three days after the operation the glass globe came out, there being slight suppuration. The same day the good eye felt weak and watery; the next day it was worse, and slight iritis was manifest. Since then typical sympathetic ophthalmitis has developed.

Lang's case.—A girl æt. 7, admitted to the Moorfields Hospital on February 25th, 1891, with the right eyeball much shrunken. It was stated to have been so since birth. There was general pinkish injection, peripheral anterior synechiæ, complete posterior synechiæ, and an appearance of atrophy about the iris. The lens appeared opaque and shrunken. T. n.; no p. l. The left eye was healthy.

The day after admission the right eye was excised and a glass globe inserted into Tenon's capsule. Pathological examination of the eyeball revealed considerable cell infiltration throughout the uveal tract, an increase of cells in the optic nerve, and some inflammatory tissue in its sheath. No evidence of any perforation of the globe was found. The vitreous was shrunken and the retina detached.

The operation was not followed by any pain, swelling, or rise of temperature. The patient left the hospital eleven days afterwards.

Eight weeks after the operation she was readmitted with iritis in the left eye. There was total posterior synechiæ, but no keratitis punctata. T. – 2. Under

treatment with atropine the condition of the eye improved, but the pupil remained excluded and occluded.

In November, 1894, a linear extraction was performed.

In January, 1895, the coloboma being quite closed, an iridotomy was done.

The final note of her condition in September, 1897, is as follows:

Right.—Socket healthy, glass globe displaced upwards and outwards.

Left.—Nebula in centre of cornea and opacities at periphery. Anterior chamber shallow. Irregular opening in iris, through which fundus can be seen. T. n. V. = fingers at 4 feet, $\bar{c}$ + 20 partly, $\bar{c}$ + 23 J. 1 at 9 inches.

We have thought it well to record these cases in this report. In the first case, however, the interval between the operation and the onset of the inflammation in the sympathising eye, viz. three days, is so short that we do not think it had anything to do with the onset of the mischief.

In the second case, as the inflammation in the excised eye was apparently spontaneous, and not the result of perforating injury, that in the second eye may have been of like nature. We do not think there is any evidence that the introduction of an artificial globe into Tenon's capsule diminishes the immunity from sympathetic ophthalmitis afforded by excision.

We have found records of cases of sympathetic ophthalmitis occurring after the operations both of optico-ciliary neurotomy and neurectomy.

Leber* reports the case of a boy æt. 8, who had a wound of the lower corneal margin followed by plastic iridocyclitis. Neurotomy was performed three months after the accident. He returned two and a half years later with iritis in the other eye, which had quite the appearance of being sympathetic. The eye in which neurotomy

* 'Archiv für Ophth.,' Bd. xxvii, Ab. 1, S. 331, 1881.

had been performed was tender. After its excision the nerve was found to be united by connective tissue only, in which micro-organisms were discovered.

Scheffels * describes the case of a boy æt. 9, who had purulo-plastic inflammation following a perforating wound of the eye. Sixteen days after the injury a neurectomy was attempted, but as only 0·5 mm. of the nerve was removed the operation more resembled a neurotomy. Six weeks after the operation the eye was shrunken, but free from pain. Three and a half months after the operation typical sympathetic irido-cyclitis had set in.

The following are brief notes of six cases of apparently undoubted sympathetic ophthalmitis occurring after optico-ciliary neurectomy.

Case 1.—Recorded by Clausen. † Boy æt. 16, wound of right eye with scissors at age of seven. Five months after accident there was an anterior synechia, but no pain or tenderness. A few weeks later there was some ciliary injection with pain. The eye then remained quiet until the age of sixteen. When seen he had had pain for eight weeks, there was intense ciliary injection, the iris was infiltrated, and the eye soft and tender.

In the left eye there was lacrymation in the morning and pain on using it, but the vision was normal.

The operation of resection was performed, and seventeen days later there was slight pain and ciliary redness of the left eye; this improved under treatment, but relapsed. Twenty days after the operation the optic disc was muddy, and the aqueous and vitreous became turbid; later severe chronic iritis set in, and vision became reduced to fingers. A year after operation eye quiet, vitreous turbid. V. = $\frac{8}{200}$.

Case 2.—Ohleman. ‡ A man æt. 27. In the left eye sclero-corneal wound from iron chip. Traumatic cataract,

* 'Kl. Monatsbl. f. Augenheilk.,' 1890, S. 197.

† 'Inaug. Dissert.,' 1886.

‡ 'Archiv für Augenheilk.,' Bd. xxii, S. 105, 1891.

blood in vitreous. Chip of iron removed with magnet. Fourteen days after healing of wound patient returned with eye painful and tender. Resection then performed. Ten weeks later eye still painful and tender. In right eye keratitis punctata; no circumcorneal injection. Optic disc thought to be redder than normal. V. = $\frac{6}{6}$ and 0·3 Snellen. Injured eye excised, sympathising eye recovered.

Case 3.—Trousseau.* Two perforating wounds of left eye, with an interval of two years, followed by blindness. Eye remained quiet and painless until four years after second wound, then it became injected and tender. Lacrymation of right eye, which was otherwise normal. Resection of left optic nerve performed. Four to five mm. of nerve removed. Ten days later left eye insensitive; no lacrymation of right eye. Ten weeks later patient returned with ciliary injection and impaired vision of right eye, which in other respects appeared normal. Left eye was not sensitive to pressure, although contact with conjunctiva was felt. Three weeks later there was severe plastic iritis in right, with opacities in vitreous. Excision of the left eye was followed by improvement, which, however, was only temporary.

Case 4.—Schmidt Rimpler.† Perforating wound of left eye. Neurectomy five months later on account of continued pain; 15 mm. of nerve removed. Nine months after operation outbreak of sympathetic inflammation. Cornea of left eye had again become sensitive. After excision of left, vision of right was restored to $\frac{1}{2}$.

Case 5.—Lindo Ferguson.‡ Man æt. 30. Perforating wound of right cornea and lens with incarceration of iris. Next day anterior synechia cut across, and portion of lens

* 'Bull. Soc. Fr. d'Ophtal.,' 1891.

† 'Archiv. für Ophth.,' Bd. xxxviii, Ab. 1, S. 199, 1891.

‡ 'Trans. Intercolonial Med. Cong. at Melbourne,' 1889, p. 733.

evacuated. Plastic cyclitis followed. Seven weeks after injury neurectomy performed; left eye at that time said to be failing, though there were no recognisable changes in it.

The operation was attended by severe hæmorrhage behind the globe, which forced it between the lids. After very great difficulty it was reduced, and the lids closed. On the following day the eye was again protruding, and could not be thoroughly reduced. The cornea was infiltrated with pus on the third day, but cleared up after threatening for over a week to necrose. Fourteen days after operation the eye was in good position. On the sixteenth day the patient had a mild attack of sympathetic iritis, which yielded to treatment. Three months later V. of L. $\frac{6}{12}$ $\bar{c}$ + 1 $\frac{6}{6}$. The right eye remained absolutely insensitive.

Case 6.—Lindo Ferguson.* Boy who had wound of cornea, iris, and lens of right eye from the peg of a top; this was followed by infiltration of the cornea and iritis. Eleven days after the injury the eye was quiet, pain had ceased, and the wound had healed with closed pupil. Thirty-six days after the injury resection was performed; at that time there was weakness of the left eye. Five days later the left eye had well-marked sympathetic iritis, which ran a severe course, leaving V. = $\frac{6}{60}$ from deposit on the capsule of the lens.

In all these cases of sympathetic ophthalmitis after optico-ciliary neurotomy or neurectomy, the eye upon which the operation was performed had received an injury, itself likely to produce sympathetic disease.

We have not found a record, or received notes of any case, of sympathetic ophthalmitis following either of these operations when the eye was not suffering from an affection itself likely to produce it. There is, therefore, no definite proof that either of these operations is itself capable of

* Case reported to committee.

exciting sympathetic inflammation, though it is possible that this has occurred in some of the above cases.

In Clausen's case, and in Lindo Ferguson's two cases, the interval between the operation and the onset of inflammation in the second eye, viz. seventeen days, sixteen days, and five days respectively, is so short as to make it in the last case impossible, and in the other two very improbable, that the operation had to do with its excitation.

In both Lindo Ferguson's cases, moreover, weakness of the second eye was noticed before the operation.

In other cases in which the sympathetic disease commenced at varying intervals from two and a half years to ten weeks after the operation, the possibility of the operation having excited it cannot be excluded.

In contrasting the relative immunity from sympathetic disease afforded by optico-ciliary neurotomy or neurectomy and excision we find, that out of the immense number of excisions which have been performed, the committee of this Society on sympathetic ophthalmitis could only discover two undoubted cases where an interval of more than eight weeks had elapsed between the excision and the occurrence of inflammation in the second eye. Out of the comparatively small number of optico-ciliary neurotomies and neurectomies which have been performed, we have been able to discover five undoubted cases in which the sympathetic disease did not make its appearance until ten weeks or longer after the operation, two after neurotomy, and three after neurectomy.

Though the occurrence of sympathetic ophthalmitis after abscision is referred to in most of the recent text-books on eye disease, only a few actual cases can be found recorded.

The following are brief abstracts of the notes of three cases.

Case 1.—Van de Bergh.* A child æt. 5, with total

* 'Annales d'Oculist,' t. c, p. 115, 1888.

anterior staphyloma of the right cornea. Abscision performed, sutures passed only through the conjunctiva. Six weeks later slight photophobia in left eye. Excision of stump advised, but refused. Eight weeks after abscision well-marked sympathetic ophthalmitis in left eye with scarcely any vision. Some months later the eye was soft, tender, shrunken, and quite blind.

Case 2.—David Little.* Man æt. 28, dense leucoma of one eye, other eye normal. Abscision performed; about two and a half months later began to wear an artificial eye. From four to five months after operation sympathetic ophthalmitis occurred. Stump not excised. Sympathetic inflammation subsided on the discontinuance of the glass eye.

Case 3.—Brudenell Carter.† A strong, healthy labourer injured while "hedging." Complete anterior staphyloma of right cornea resulted. Abscision performed. Sympathetic ophthalmitis ensued from four to six weeks later. The stump of the eye was excised, but the sympathetic inflammation went on to complete destruction of the eye. The length of time which elapsed between the date of injury and the operation of abscision is not mentioned.

Eyes with staphylomatous and leucomatous corneæ are not, when left to themselves, prone to excite sympathetic ophthalmitis, whereas wounds of the ciliary region are known to do so frequently.

In Critchett's operation of abscision the ciliary body is penetrated by needles, and sutures are inserted in that region. Should sympathetic inflammation occur after such an operation, performed on an eye with anterior staphyloma, it would seem *a priori* likely that the disease in the second eye had been excited by the operation rather than by the original disease.

* 'Trans. Ophth. Soc.,' vol. vi, p. 227.

† 'Med.-Chir. Trans.,' vol. lvii, 1874, p. 193.

In the first case above quoted the sutures were only passed through the conjunctiva.

The time which elapsed between the operation and the onset of the sympathetic mischief in these three cases, viz. from four to six weeks, is such that the affection of the second eye might well be attributed to the operation. It is not longer, however, than that which has been known to elapse between excision and onset of sympathetic inflammation.*

III. What are the Disadvantages of the Several Operations under Consideration, apart from the Risks of Meningitis and Sympathetic Inflammation?

The following disadvantages of simple excision have been suggested:

(i) The deformity which necessitates the wearing of an artificial eye. This is common to all the other operations except optico-ciliary neurotomy and neurectomy.

(ii) Defective prominence and imperfect movement of the artificial eye.

(iii) The faulty development of the orbit and face on the side from which the eye has been removed, when the operation has been performed in early life. Though often referred to in ophthalmic literature, we have been unable to find any definite evidence in support of this suggestion.

Gordon Byers sends us notes of ten cases (*vide* Appendix) in which the eyeball was removed in childhood, and which he examined as adults. He estimated by means of compasses the transverse and vertical diameters of the external orifices of the orbits on the two sides. The differences found between those of the empty orbits and those of the sides unaffected were so slight, that they could readily be accounted for by the difficulty in obtaining exactly the same fixed points. His observations went to show that no arrest of development had occurred,

* 'Trans. Ophth. Soc.,' vol. vi, p. 192.

at any rate as far as the external orifices of the bony walls of the orbit were concerned.

The disadvantages of evisceration without the insertion of an artificial globe, Graefe's operation, are—

1. Excessive reaction and prolonged stay in hospital.
2. Sloughing of sclerotic.
3. Subsequent pain or irritation in stump.

1. *Excessive reaction and prolonged stay in hospital.*—Out of 200 cases of evisceration without the insertion of an artificial globe, recorded by Bunge,* in only five did excessive reaction occur, *i. e.* so severe as to necessitate a stay in the hospital longer than 12 days.

The length of stay of each of these patients in the hospital was 24, 24, 16, 13, and 15 days respectively. On the other hand, five were retained in the hospital less than 5 days, and of these, two only 3 days.

That the reaction after evisceration may be very severe, and considerably in excess of anything which is met with after simple excision, is shown by a case recorded by Knapp † in which the condition of the patient became so alarming that it has led him to abandon the operation.

The case was that of a man with staphyloma of the cornea after recent blennorrhagic ophthalmia. When the bleeding had ceased the wound was united with sutures. Soon afterwards the eyeball became moderately filled with blood. The next morning the upper lid was swollen, the eyeball tightly filled, blood oozing out of it. The swelling, pain, and tension of tissues increased. The chemosed conjunctiva prevented closure of the palpebral fissure. There was never any suppuration, but for three days the patient was apathetic and drowsy, with dull headache and loss of appetite. On the sixth day after the operation he was better. By the thirteenth day there was a decided improvement, and ultimately he completely recovered.

* 'Ueber Exenteration des Auges,' 1887.

† 'Archives of Ophthalmology,' vol. xiv, 1885, p. 307.

2. *Sloughing of sclerotic.*—Sloughing of the sclerotic after Graefe's operation of evisceration has been met with by Albini* in a case in which he performed the operation for panophthalmitis.

The notes of the following case in which the sclerotic sloughed have been furnished us by Treacher Collins.

A man æt. 55, admitted with much œdema of lids, conjunctival muco-purulent discharge, sloughing of cornea, and suppuration of the contents of the globe, as the result of a lime burn. Evisceration performed, the cornea cut away, contents of globe removed with a scoop, nothing but sclerotic being left; no sutures inserted, and all antiseptic precautions taken.

The swelling of lids and conjunctiva continued until two days after the operation, when it began to subside, and the patient had less pain and was less drowsy than at first. The third day after the operation the sclerotic was noted to be yellow and sloughing. Pieces of sclerotic continued to slough and separate for a month afterwards, when he left the hospital.

3. *Pain or irritation in stump.*—Albini records a case in which after Graefe's operation of evisceration the stump left was painful.†

The suggested disadvantages of Mules' operation are—

1. Excessive reaction.
2. Sloughing of sclerotic.
3. Prolonged stay of patient in the hospital.
4. Escape of artificial globe.
5. Breakage of artificial globe.
6. Subsequent pain or irritation in stump.

1. *Excessive reaction.*—The amount of reaction which follows Mules' operation varies considerably; it is always more than after simple excision. In a case recorded by

* 'Gazzetta delle Cliniche,' No. 18, 1886.

† 'Gazz. degli Hospitali,' Nos. 80, 81, and 82, 1885.

Sydney Stephenson,* of which the following is a brief abstract, it was very excessive.

Stephenson commences by stating that this was the only bad result he had had out of thirty operations.

A boy æt. 10 had had his eye wounded six years previously. On January 7th, 1892, Mules' operation was performed, and a glass sphere of the smallest size but one was inserted. Ordinary antiseptic precautions were taken. During the course of the two following days reaction was marked by the usual signs, viz. slight rise of temperature, pain in the eye, swelling of the lids, and a certain amount of chemosis. Four days after the operation the chemosis had increased markedly, and formed a yellowish fold flecked with hæmorrhagic points. Some small white vesicles had also formed on the lids. Six days after the operation the chemosis was still more extensive, presenting somewhat the appearance of a tomato, protruding from the palpebral fissure. Numerous punctures were made into the swollen conjunctiva and ice applied. A week after the operation, the stitches having given way and the globe being exposed, it was removed.

The chemosis continued to increase, and on January 20th, thirteen days after the operation, a lake-coloured fold of conjunctiva lay on the cheek, and measured 40 mm. by 15 mm.; a month later the conjunctival protrusion measured 25 mm. by 10 mm., and could be seen to arise wholly from the lower lid. Ninety-three days after the evisceration a second operation was performed, "the orbital stump" being removed. The patient was last seen about two years after the evisceration. The conjunctiva was then a good deal thickened, and was disposed in a bunch-like way. An artificial eye had been introduced on more than one occasion, but its use was ultimately abandoned, since it caused irritation of the stump, as shown by discomfort, redness, and discharge.

* 'Lancet,' 1894, ii, p. 683.

Frost and Grimsdale, as the result of their experience drawn from 120 cases of Mules' operation (*vide* Appendix), say with regard to the reaction that the amount varied much in different cases. "It was certainly greater in the earlier than in the later cases. It was not sufficient in any case to cause alarm, or to necessitate the removal of the sphere.

"In the cases in which the reaction was most severe the upper lid became much swollen, and there was a good deal of pain. In many of these cases the conjunctiva became much chemosed, and protruded between the lids. When this occurred its circulation became impeded by the pressure of the lids, and the swelling of the protruded portion increased. In consequence of this a semi-solid mass of infiltrated conjunctiva would sometimes remain protruding long after the case was otherwise well. It was always connected with the conjunctiva below the wound. It was dealt with in various ways. In some cases it was excised, while in the majority it slowly diminished. As soon as it became sufficiently reduced for the lids to be brought over it, it rapidly subsided. In a few cases the lids were stitched together over the swelling with excellent results."

In two cases operated on by Lang at the Moorfields Hospital, in which considerable reaction followed (swelling of the lids and conjunctiva, &c.), the patients became very hysterical. One was a woman aged twenty-four, and the other a girl aged nineteen. In the first case the patient ultimately did well and obtained a good stump. In the second case the artificial globe escaped on the eleventh day.

Bickerton, who has performed the operation fifty times, has never known suppurative orbital cellulitis to occur. He found that the swelling had generally completely disappeared by the tenth day. He believes that the severity of the pain does not usually bear any direct relation to the degree of swelling, for while pain is greatest during

the first forty-eight hours, swelling is generally greatest on the third and fourth day.

With regard to the amount of febrile reaction, Bickerton says it is usually slight, the temperature rising about a degree on the second or third day, the pulse being accelerated in proportion. In many of his cases the temperature did not rise above 99°. In one case it rose to 102·4°, and in another to 100°; in both sloughing of the sclerotic occurred.

Webster Fox* has recorded two cases in which the temperature went as high as 105°.

Vomiting, sometimes severe, and more than can be attributed to the effects of the anæsthetic, occasionally follows the operation.

Bickerton sends us notes of the case of a girl who had constant retching and vomiting for nearly a week; and also those of a man aged fifty-three who vomited for eight hours after the operation.

2. *Sloughing of the sclerotic.*—This seems to be an occasional but rare occurrence after Mules' operation.

Mules mentions to us that in one of his cases the sclerotic necrosed. This he attributed to the use of hot corrosive sublimate solution used to arrest bleeding in an old glaucomatous eye.

Frost and Grimsdale send us the following case.

William B—, æt. 51. A perforating injury, followed by sloughing of the cornea and hypopyon. Mules' operation two months after the accident. The choroid was thickened, and was scooped away with difficulty. The sphere escaped on the sixth day. A considerable portion of the sclerotic sloughed, taking many weeks to come away.

Bickerton says he has seen sloughing of the sclerotic in two cases. One of these was a boy aged fourteen, who was operated on for a recent perforating wound of

* Amer. Med. Assoc., Ophth. Section, May 7th, 1895.

the ciliary region, with detachment of the retina. Necrosis of the sclera followed, and it escaped *en masse*.

The other case was a plethoric man aged fifty-four, who was operated on for panophthalmitis after destruction of the cornea and part of the sclerotic by molten brass. The sclerotic sloughed and was slowly discharged as débris for the ensuing three months, the globe escaping on the ninth day.

3. *Prolonged stay of patient in the hospital.*—It has been suggested that the prolonged time which patients have to remain under treatment after Mules' operation might become a serious objection to its universal practice in hospitals where the pressure on the accommodation for in-patients is great.

Frost and Grimsdale state that in their 120 cases the average time in the hospital after the operation was seventeen days. The average after excision they found to be ten days.

The average time that patients remain in the hospital after excision at the Moorfields Hospital is considerably less.

Maclennan, the house surgeon, estimated that the average stay in fifty cases which were not retained for the treatment of an affection of the other eye was 3·61 days.

In eight cases of Mules' operation performed at the Moorfields Hospital by Treacher Collins the average stay in the hospital was twelve days.

In Bickerton's cases of Mules' operation the average length of stay of the patients in the hospital was fourteen days, and the average stay in bed ten days.

It is probable that the length of stay in a hospital is to a great extent influenced by the relative scarcity of beds.

4. *Escape of the artificial globe.*—When the artificial globe escapes it usually does so within a few weeks of the operation.

Frost and Grimsdale have divided their 100 cases into "successful"—those in which the scleral wound was healed in its whole extent when the patient was dis-

charged; "partially successful"—when at the time of the patient's discharge the sphere was in part exposed, but the ultimate result not known; and "unsuccessful"—where the sphere escaped or was removed.

Successful	...	82 cases	...	68 per cent.
Unsuccessful	...	35 ,,	...	30 ,,
Partially successful	...	3 ,,	...	2 ,,
		120		100

Hartridge imforms us that in nineteen cases of Mules' operation which he has performed the glass globe came out in six (31·5 per cent.), usually between the tenth and fourteenth days.

Power and Vernon send us a list of thirteen cases of Mules' operation, in three of which the globe escaped (23 per cent.).

Bickerton * records forty cases, in five only of which the globe was extruded (12·5 per cent.).

Several recorded cases show that the artificial globe may be retained for many years and the stump remain in a satisfactory condition.

For instance, when Mules first brought before this Society the subject of evisceration he exhibited a patient upon whom Hill Griffith had performed the operation a month previously. Ten years later this patient was again seen by Mules, who found that he had been wearing the artificial eye regularly, and that the cicatrix was perfectly sound.

Brudenell Carter,† writing in July, 1897, says he has lately seen three patients upon whom he had performed this operation in 1886, 1887, and 1888 respectively, and who were still wearing artificial eyes with perfect comfort and with natural appearance.

Frost and Grimsdale send us notes of another case operated on by Brudenell Carter in 1887, and seen nine

* 'Brit. Med. Journ.,' 1896, ii, p. 814.

† 'Lancet,' July, 1897.

years after, wearing an artificial eye, and having no trouble with the stump. They also record eighteen cases in which the patients were seen more than six months after the operation :

6 months to 1 year	3 cases.
1 to 4 years	9 „
Over 4 years	6 „
	18

These two observers have endeavoured to determine in what class of cases and at what age the operation is most successful, and have arrived at the following results (for the figures, &c., on which they are based see Appendix).

The most favorable cases were those of corneal opacity in patients over fifteen ; the failures in these were only 13·5 per cent. Patients over fifteen, however, did not yield good results (in cases of recent injury), for the failures amounted to 45 per cent. The results seem to show that while cases of corneal opacity give better results than those of injury at all periods of life, the results are much better after puberty than before (13·3 per cent. and 30 per cent. of failures) ; cases of recent injury do better before puberty than later (20 per cent. and 45 per cent. of failures).

They have also found that with their increasing experience of the operation their percentage of failures diminished ; thus they had in the first six years sixty-two cases with 35·5 per cent. of failures, and in the last six, fifty-eight with 24 per cent. failures.

If the wound has once firmly and completely closed over the artificial globe it does not, as a rule, subsequently give way and reopen. We have, however, been able to collect the notes of seven cases in which reopening of the wound did occur, in one as late as six years, and in another five years after the operation.

Brief notes of three cases sent us by Bickerton :

Case 1.—A girl æt. 7, in whom the cicatrix remained

firm for over six months. An artificial eye was supplied on the twelfth day. The patient's mother, in spite of warning, allowed the eye to be worn continuously, often for more than a week at a time, provoking much irritation of socket. The cicatrix gave way and the globe escaped seven months and twenty-five days after the operation.

Case 2.—A woman æt. 29, upon whom Mules' operation was performed for severe pain in an old injured eye. The patient left the hospital in a fortnight, the wound being then well healed. Thirty-eight days after the operation an aperture of 3 mm. was noticed in the centre of the cicatrix. Further history of case not known. Patient of intemperate habits.

Case 3.—A man æt. 54. Operation performed on an old injured eye, which had recently become painful. Considerable reaction followed, but swelling had commenced to subside by the fifth day, from which time recovery was rapid, and patient was early able to wear an artificial eye.

Three months after operation a minute opening in centre of cicatrix was noticed; this increased to the size of a sixpenny piece, and ultimately seventeen months after operation it was removed.

Notes communicated to us by Frost and Grimsdale:

Thomas B—, æt. 35. Contusion without wound six weeks before operation in 1892; pain and increased tension. Mules' operation performed by Carter. Much conjunctival swelling followed. Sutures removed thirteenth day. Seen December, 1894, wearing a very rough artificial eye. Condition of cicatrix then not stated in the notes (it would certainly have been noted had it shown any sign of giving way).

In June, 1897, the patient attended and brought up the sphere, saying that the sphere had escaped three weeks before. He had not noticed that the sphere was exposed, but for some time past had occasionally heard

the artificial eye strike against something hard on being introduced. The anterior half of the sphere was white and rough, as if it had been exposed for a long time.

Notes of two cases recorded by Brudenell Carter:*

First case operated on in November, 1887; a man over seventy. Eye wounded with a piece of wood, septic inflammation ensuing.

In June, 1891, irritation of stump; had been wearing the same artificial eye, usually day and night, for three years and a half.

In February, 1894, cicatrix was found to have given way and glass globe to be exposed.

Second case a middle-aged man. Operation performed on account of intra-ocular growth. Healing was complete, but the patient returned in the following November with an opening and the ball exposed. It was left out, and the sclera, which was perfectly clean, smooth, and white, collapsed.

In 1889 he returned with stump painful and irregularly distended. It was removed, and the distension found to have been occasioned by an accumulation of watery fluid.

Notes of case communicated to us by John Griffiths:

William C—, æt. 22, brewer's labourer, had his right eye wounded by the bursting of a bottle on June 5th, 1895. Mules' operation performed same day. Operation successful. He attended a year later with an attack of catarrhal ophthalmia in the socket. This was cured, but a second attack came on last October (1897), and the glass ball became exposed and was expelled eleven days later. He had worn a glass eye constantly from two months after the operation, only leaving it out at the time of the ophthalmia for a week or ten days. The movements were excellent. He now wears the glass eye upon the scleral stump with fair movement.

* 'Lancet,' July 31st, 1897.

5. *Breakage of artificial globe.*—It has been several times urged as an objection to the introduction of a hollow glass globe into the sclerotic that a sharp blow inflicted on the stump might fracture it, and leave the sclerotic filled with fragments of glass.

W. E. Keall* of Bristol, to meet this objection, substituted hollow silver globes for the glass ones. These metal globes do not seem to have been nearly so extensively used.

We have not received notes of any cases, nor do we know of any that have been recorded, in which the glass globe has been broken after its insertion.

We have found two cases in which silver globes have been inserted, followed by argyriosis of the stump: in one operated on by Richardson Cross, of which the details are given on p. 268; in the other case, reported by Bickerton (*vide* Appendix), a bluish-black appearance of the stump was noticed six months after operation.

6. *Subsequent pain or irritation of stump.*—Frost and Grimsdale only know of one of their 120 cases in which there was any after trouble of this nature. In this patient, two years after the operation the stump was irritable, with lacrymation and mucous discharge. This subsided under treatment, but it recurred eighteen months later. A mass of "cockscomb" granulation was now discovered in the upper *cul-de-sac*. This was excised, and there was no further trouble.

H. H. Folker has met with three cases in which he afterwards performed excision on account of pain in the stump. In the first of these the patient, aged forty-one, had a Mules' operation performed on the right eye, and two years afterwards suffered intense pain in the stump with sensations of light and sensitiveness of the other eye.

In the second case the patient, aged thirty-seven, had a Mules' operation performed for corneal staphyloma,

* 'Trans. Ophth. Soc.,' vol. vi, p. 507.

and a year later requested to have the eye removed, as the pain in it was so acute.

The third case was a patient aged forty-five, who had been operated upon by Mules himself, and who four years after complained of great pain, which was accompanied by marked injection, swelling of the lids, and photophobia of the other eye.

The following case was communicated by Richardson Cross to this Society at the June meeting in 1897 :

On May 20th, 1887, Mules' operation with insertion of a silver globe performed on a man who had a few hours before received an injury to the eye. Patient left hospital in ten days, and a glass eye was worn with absolute comfort for eight and a half years.

He then returned complaining of pain in socket which prevented sleep, and inability to wear artificial eye over the stump for some weeks.

There was a well-defined blackish-red mass towards the apex of the orbit, somewhat resembling a melanotic sarcoma.

Multiple punctures having failed to relieve the symptoms, a free incision allowed the escape of a blackened silver ball, which had caused argyriosis through the sclera and its conjunctival covering.

The possible disadvantages of the insertion of an artificial globe into Tenon's capsule are—

1. Escape of the artificial globe.
2. Amount of reaction and prolonged stay in hospital.
3. Breakage of artificial globe.
4. Displacement of artificial globe outside the cone of muscles.

1. *Escape of the artificial globe.*—Out of forty cases operated on by Lang (*vide* Appendix), in six the globe escaped previous to the patient leaving the hospital from the fifth to the ninth day.

As several of the later cases were discharged from the

hospital on the fourth day, it is possible that the total number in which the globe escaped was a good deal larger.

In one case it is known definitely that the globe did escape six weeks after the operation, after the patient had left the hospital.

Frost performed this operation in six cases, but in only one was the globe retained.

That the globe in many of these cases may be retained for many years is definitely proved by six of Lang's cases, which were seen at the following dates after the operation:

1. 4½ years after.
2. 10 ,,
3. 10 ,,
4. 10 ,,
5. 9 ,,
6. 8 ,,

In all except the first and last of these cases an artificial eye had been worn since the operation.

2. *Amount of reaction and prolonged stay in hospital.*—The amount of reaction after the insertion of an artificial globe into Tenon's capsule is very slight. In only three of Lang's forty cases was any undue swelling of lids or conjunctiva noted. The length of stay of the patients in the hospital in most of Lang's later cases was not longer than after ordinary excision.

3. *Breakage of the artificial globe.*—Breakage of a glass globe implanted into Tenon's capsule might prove a source of more trouble than the breakage of a glass globe implanted in the sclerotic. In the latter case the sclerotic and its contents could be removed from Tenon's capsule without opening up the fat of the orbit, whereas in the removal of Tenon's capsule and its contents the fat of the orbit must necessarily be cut into. Lang in twelve of his forty cases implanted globes made of celluloid, and in one case a globe made of silver.

In three of the cases in which celluloid globes were implanted, the globe was known to have escaped. In no case is it known definitely that a celluloid globe has been retained for several years.

We know of no case in which a glass globe implanted into Tenon's capsule has subsequently been broken.

4. *Displacement of artificial globe outside the cone of muscles.*—Frost gives only one instance of this operation in which the sphere was known to be retained; it was too small to be of much service, and it appeared to have become displaced, so as to lie outside of the cone of muscles.

In four of the six cases of Lang's in which the globe was retained for several years, it has remained in a good position in the centre of the socket. In one case it was displaced upwards, and in another outwards.

The displacement of the globe had not interfered with the wearing of an artificial eye.

The disadvantages of optico-ciliary neurotomy and neurectomy are—

1. Free hæmorrhage into the orbit and protrusion of the eyeball.
2. Ulceration of the cornea.
3. Return of pain.
4. The development of papillitis in the other eye.

1. *Free hæmorrhage into the orbit and protrusion of the eyeball.*—Hæmorrhage into the orbit and a certain amount of protrusion of the eyeball always accompany both operations. As a rule the hæmorrhage is not excessive, and can be easily controlled by pressure. Occasionally, however, it is severe, as in the case of Lindo Ferguson's already quoted (pp. 252, 253); there is then considerable trouble in getting the lids to meet, and maintaining them in apposition over the proptosed globe. Should they not meet, and the cornea be for a time left exposed, the risk of its ulcerating is much increased.

2. *Ulceration of the cornea.*—Several cases of ulceration

of the cornea after optico-ciliary neurotomy have been recorded by Landesberg,* Leber,† Ridard,‡ and others.

Out of fifty-three recorded cases collected by Poncet,§ destruction of the eye or of the cornea by suppuration appears to have occurred five times.

Lindo Ferguson informs us that he has performed the operation of optico-ciliary neurectomy between thirty and forty times, but has not met with any case in which ulceration of the cornea ensued. He says, "At first I was nervous as to injury of the insensitive cornea from small foreign bodies which might not be felt, but I have seen no bad results, and have seen one case eight years after operation."

3. *Return of pain after operation.*—Landesberg || records the case of a boy æt. 8, who had a corneal cicatrix with anterior synechia and tenderness of the ciliary region, while in the other eye there was circumcorneal injection, a sluggish pupil, photophobia, and lacrymation. Neurotomy was performed. Three weeks later the sensibility of the cornea had returned, and there was severe irritation of the ciliary region. The condition of the other eye remained unchanged until excision was performed, when it rapidly improved.

Lindo Ferguson informs us that he has had two cases in which the operation (neurectomy) was performed for glaucomatous pain without relief. In one of these cases the pain was subsequently relieved by an iridectomy, and in the other the eye was excised by another surgeon.

Treacher Collins ¶ has recorded two cases of absolute glaucoma, one in which neurotomy, and the other in which neurectomy was performed at Moorfields Hospital for the relief of pain. In the first case the pain returned,

* 'Klin. Monatsbl. für Augenheilk.,' 1881, Bd. xiv, S. 371.

† 'Archiv f. Ophth.,' Bd. xxvii, Ab. 1, S. 323, 1881.

‡ 'De la Section des Nerfs optique et ciliaires,' Inaug. Diss., 1879.

§ 'Annales d'oculistique,' 1882, p. 74.

|| 'Kl. Monatsbl. für Augenheilk.,' 1891.

¶ 'Roy. Lond. Ophth. Hosp. Reports,' vol. xiii, pp. 198 and 200.

and the cornea became ulcerated two years after the operation; the eyeball was then excised.

In the second case an iridectomy had been done, but the tension had not been permanently diminished by it. A neurectomy was then performed and the pain for a time relieved, but two and a half years later it returned, and the eyeball was removed.

4. *Papillitis in the other eye.*—Schweigger * gives two cases in which this complication occurred. It will be noted that in neither was the condition of the eye operated on one that usually causes sympathetic mischief.

Anna B—, æt. 20. Right eye attacked by inflammation a year ago. This recurred frequently. When admitted there was violent inflammation of the right eye, which had been present three weeks. The eyelids were red and swollen, and the ciliary region was tender. Total posterior synechia. Violent pain in the eye and over the whole of right side of head. No perception of light. Left eye normal. Neurectomy on day of admission. Twelve days later vision of left eye = $\frac{1}{3}$, read 0·4 with difficulty. Field of vision normal.

Ophthalmoscopic appearances. — Optic disc margin blurred, opaque-looking, swollen and greyish. A hæmorrhage on the nasal side. The papillitis subsided, and vision returned to normal. Two years later it was still normal, and there had been no return of inflammation in the right eye.

Marie W—, æt. 27. Inflammation of right eye causing blindness several years. Frequent relapses. Circumcorneal injection, total posterior synechia, iris bombé. Left eye normal, but lately photophobia, lacrymation and asthenopia. Neurectomy. Nine days later optic disc of left eye blurred, somewhat swollen, vessels tortuous, partly covered by exudation. Vision normal. The ophthalmoscopic ap-

* Knapp's 'Arch. of Ophth.,' vol. xiv, p. 231.

pearances disappeared in the course of four weeks, vision remaining normal throughout.

The disadvantages of abscision mentioned in literature on the subject are:

1. Hæmorrhage.
2. Suppuration.
3. Irritability of the stump, with or without sympathetic irritation of the other eye.

Of the first two complications we have been unable to find any recorded examples to quote.

3. *Irritability of the stump, with or without sympathetic irritation of the other eye.*—The following is a case reported by Poncet.*

Patient's right eye shrunken after ophthalmia; a glass eye was worn over the shrunken globe, and the latter became painful. Abscision was performed, but pain returned with symptoms of irritation in the other eye. After excision of the stump pain was relieved, and the other eye rapidly improved.

Case communicated to us by Priestley Smith.—Walter A—, æt. 15. When fourteen months old left eye lost from purulent ophthalmia. At three years of age abscision performed. About twelve months ago the right eye, hitherto strong and well open, began to look smaller, to face the light with difficulty, and to have attacks of redness, especially in the evenings. These attacks continued and became more frequent, the boy frequently starting up in his sleep. A weak alum lotion producing no improvement, the left shrunken eye was excised; it contained a cup of bone posteriorly. A month later there was very marked improvement in the remaining eye. It faced the light well, and other symptoms had disappeared.

Case communicated to us by Mr. Treacher Collins.—Boy æt. 8. The sight of his right eye destroyed by ophthalmia

* 'Soc. Franç. Opht.,' 1883, p. 103.

neonatorum. Operation of abscision performed shortly afterwards. Seven years later complained of pain, tenderness of the stump, and inability to wear a glass eye on account of the irritation it caused. Stump of eyeball excised and found to contain bone.

In the museum of the Moorfields Hospital is the stump of an eye removed two and a half years after the operation of abscision, which was performed on account of a wound by a nail. It had to be excised on account of pain.*

Two cases communicated to us by Mr. Ernest Clarke.—Julia R—, æt. 16, seen at the Central London Ophthalmic Hospital in March, 1897. Abscision had been performed on her right eye in early childhood, and until recently it had given her no trouble. The stump was painful and the left eye considerably inflamed. The stump was excised, and on being opened showed the choroid completely ossified. The inflammation in the left eye developed into a sharp attack of vascular keratitis, which after some weeks subsided, leaving a dense opacity of the outer half of the cornea.

Mr. S—, æt. 60. Seen in June, 1896. Twenty years previously abscision had been performed on the right eye after an injury. The stump gave no trouble until March, 1896, when it became painful. Six weeks later the left eye became irritable. When seen in June, 1896, there were marked signs of sympathetic irritation in the left eye, and the stump of the right eye was very painful on pressure. It was excised, and when opened was found to contain a hollow bony sphere. The left eye completely recovered, and was normal a year later.

* 'Descriptive Catalogue of Museum,' p. 73, specimen No. 37, series 1, sub-series f.

IV. What are the Special Advantages with Relation to the Wearing of an Artificial Eye?

After all the operations under consideration, with the exception of optico-ciliary neurotomy and neurectomy, it is necessary that an artificial eye should be worn to conceal the deformity produced. After simple excision, in the large majority of cases, the artificial eye is not so prominent as the natural one; it has a sunken appearance, its range of movement is considerably restricted, and sometimes the palpebral aperture is narrower than normal.

The use of the artificial eye after this operation is liable, especially if it gives rise to any irritation, to cause an accumulation of the secretion from the conjunctiva to collect in the hollow space behind it. This from time to time overflows, giving the eye a watery appearance or allowing strands of coagulated mucus to form on its surface.

The sunken appearance of the glass eye is avoided after the operation of abscision, evisceration with the insertion of an artificial globe into the sclerotic, or excision with the insertion of an artificial globe into Tenon's capsule.

The portion of the eyeball which is left, or the embedded artificial globe, forms a support for the glass eye which serves to keep it pressed forwards in contact with the inner surface of the eyelids. In this way the normal relation of the eyelids and eyeball are closely simulated and the surface of the artificial eye is consequently kept clean and bright.

After these three operations the accumulation of conjunctival secretion in a space behind the artificial eye is also avoided, because its concavity is occupied by the stump.

The movements of the *artificial eye* are never, whatever operation is performed, as extensive as those of the normal eye, being necessarily limited by the depth of the conjunctival sac. The movements of the *stump* after abscision or Mules's operation, and sometimes after the insertion of a globe into Tenon's capsule, are almost as

extensive as that of the eyeball. The average amount of movement obtained in the artificial eye is greater after these three operations than after simple excision. The lateral movements are generally more restricted than the vertical.

V. What Points are there to be emphasised in the Technique of the Operations under Consideration?

Simple excision.—Of the technique of the operation of simple excision the Committee think it unnecessary to enter into details. In excising suppurating eyes, however, they would lay stress on the importance of thoroughly irrigating the conjunctival sac before commencing the operation; of taking every possible precaution to prevent the escape of the purulent contents of the globe into the wound; of thoroughly washing out the socket with antiseptic lotion on its completion, and afterwards of only applying lightly a pad of antiseptic wool over the closed lids.

Mules' operation.—With regard to the technique of Mules' operation, those who have had most experience of it are agreed as to the importance of the following particulars:

(*a*) The necessity for the use of strict antiseptic precautions, including the thorough flushing out of the sclerotic with antiseptic fluid previous to the insertion of the artificial globe.

(*b*) The thorough cleansing of the inner surface of the sclerotic and the removal of all shreds of choroid and retina from it, either by wiping with wool wrapped round forceps, or with the scoop specially constructed for the purpose.

(*c*) The arrest of hæmorrhage, which can be easily obtained either by flushing the interior of the sclerotic with lotion, packing it with bits of sponge or sterilised gauze, holding the sclerotic over the artificial globe with forceps, or by the use of Brudenell Carter's tampon.

(*d*) The insertion of a glass globe of such a size that it

fits loosely and allows the edges of the sclerotic to come into apposition without any traction.

(*e*) The accurate apposition of the edges of the wound and the removal of projecting angles.

To facilitate the introduction of the glass globe, Mules recommended that the sclerotic should be slit vertically. The invention of the "artificial vitreous insertor," described and pictured in the 'Brit. Med. Journ.,' 1888, vol. i, p. 26, has removed the necessity for any such slit in the majority of cases.

Bickerton recommends the use of silver-gilt spheres, because considerable pressure can be used by the insertor in their introduction without the fear of breakage.

Should it be found necessary to insert a smaller globe than the one first introduced, Bickerton advises caution in the avoidance of traction on the optic nerve in the extraction of the unsuitable one. He records a case in which traction undoubtedly did occur where persistent nausea and vomiting followed, lasting four days.

Some operators lay stress on division of the conjunctiva separately from the sclerotic, and also separation of it back from the sclerotic as far the equator. Others incise the sclerotic and conjunctiva together. These latter pass their sutures through both structures simultaneously, while the former suture the sclerotic and conjunctiva separately at right angles to one another.

Mules * advocated the introduction of a horsehair drain into the orbital tissue on the completion of the operation, as a means of lessening the ensuing reaction.

He cuts the external canthus and burrows freely into the orbit with a pair of sharp scissors to the back of the sclerotic, taking special care to open the subscleral space; he then introduces an antisepticised horsehair drain, the cut ends just passing through the cut canthus. This introduction of a drain does not seem to have been practised much by other operators.

Mules originally recommended prepared catgut to be

* 'Brit. Med. Journ.,' 1887, vol. i, p. 1213.

used for sutures; silk, horsehair, and silver wire have also been tried.

Frost and Grimsdale inform us the "material of the sutures in their cases did not appear to be of much consequence; silver was abandoned because it was found troublesome to remove. Silk and catgut were employed the more frequently."

Hill Griffith says "catgut is better than silk, for the latter requires to be removed or is apt to cut its way through the sclerotic, leaving little openings corresponding to the knots."

Bickerton prefers boiled chromicised catgut. He has found the stiff ends of horsehair cause irritation and provoke spasm of the lids.

With regard to the after-treatment, the application of ice compresses or an ice-bag for the first twenty-four hours is generally regarded as the best means of diminishing the amount of reaction.

The importance of a careful examination of the hollow artificial globe, previous to its insertion, to ascertain that it is perfect in construction, is shown by the following case reported to us by Frost and Grimsdale:

Ann R—, æt. 63. Glaucoma of old standing. The wound, after Mules' operation, did not heal in the centre, and an attempt to close it failed. She returned four and a half years later, with the opening the size of a cornea. In the centre of the exposed portion of the sphere was a pinhole aperture, and the sphere was about one-third full of pus. The authors suggest that the opening was due to defective closure in the manufacture.

When the tissues fail to completely unite over the surface of the artificial globe, and a fistula is left in which it is exposed, the usual course of events is for this opening gradually to increase in size, until ultimately the globe escapes.

Three forms of treatment have been adopted to remedy this condition:

(1) Refreshing of the edges of the opening and the bringing of them together.

(2) Removal of the artificial globe, the paring of the edges of the wound, and the insertion of a smaller globe.

(3) Paring the edges of the aperture, and grafting, so as to cover it, a piece of mucous membrane from the patient's lip.

We have no notes of any case in which the first mode of treatment proved successful, though it has been frequently tried.

Mules informs us that in two cases he had occasion to adopt the second mode of procedure, and that both did well.

The following are the notes of a case of Lang's in which it proved successful.

William N. W—, æt. 17. Inflamed eye with a foreign body in it. Mules' operation performed July, 1886. Wound gave way and globe escaped thirty-nine days later; a smaller globe was then inserted, which was retained, the tissues healing completely over it. The patient left the hospital nineteen days after the insertion of the second globe.

The third mode of treatment, suggested by John Griffith, was successfully put into practice in the following case by Juler.

R. C—, æt. 51, had his right eye injured by a pair of scissors when three years old. The sight was destroyed. He had no trouble with the eye until he was forty-eight, when it became acutely inflamed. Subsequent attacks of inflammation led to the performance of Mules' operation by Juler on April 17th, 1896. Two months later a small central aperture was noticed, and the glass ball was visible. The edge of the opening was pared, and a graft of mucous membrane from the patient's lip was implanted. The graft was kept in place by a piece of green protective, and it readily united and closed the aperture. Eighteen months afterwards the glass ball was still completely covered.

Insertion of artificial globe into Tenon's capsule.—Concerning the technique of the operation for the insertion of an artificial globe into Tenon's capsule, we have nothing to add to what has been laid down by Lang * in his communication on the subject to this Society, because the operation does not seem to have been practised with success by others.

Lang recommended that the size of the artificial globe used should be $\frac{2}{3}$ that of the excised eye. That after excision of the eyeball Tenon's capsule should be irrigated with iced antiseptic lotion. That Tenon's capsule should be united over the globe by three fine silk sutures. That a few horsehairs should be put under these sutures to act as a drain. That the conjunctiva should be united independently and horizontally by three more sutures, and that an iced pad of alembroth wool should be applied.

Optico-ciliary neurectomy.—For the performance of optico-ciliary neurectomy both Schweigger and Lindo Ferguson recommend that the nerve should be approached from the inner side.

The former states that he is convinced, from a long series of experiments, that the removal of a piece of the optic nerve 10 mm. long is not feasible from the outer side.

Both these operators recommended that the internal rectus muscle should be secured with a stitch, either immediately before or just after it is divided.

Schweigger draws forward the globe with a small pointed double hook, and after the nerve has been cut through as far back as possible with scissors curved on the flat, exposes the posterior surface of the globe by rotating it forwards with the hook.

Lindo Ferguson has had constructed a pair of curved scissors with a clamp on the concave surface. With this instrument he cuts the nerve, at the same time clamping its ocular end, and thus is enabled to rotate the posterior pole outwards with great facility. He says: "I look on

* 'Trans. Ophth. Soc.,' vol. vii, p. 286.

it as absolutely essential that the eye should be completely rotated till the nerve entrance occupies the position usually occupied by the cornea, in order that the whole back of the globe may be seen, and the ciliary nerves snipped away in daylight."

Schweigger not only cuts off the optic nerve remaining on the eyeball, and bares by dissection the whole posterior surface of the sclerotic, but also divides the insertions of the oblique muscles.

The reduction of the proptosis caused by hæmorrhage is assisted, Lindo Ferguson says, by passing the curved scissors behind the globe to allow of some of the blood escaping.

Schweigger, after having united the tendon by catgut threads previously introduced, and closed the conjunctival wound, stitches the lids together with three silk sutures as a precaution against the development of an undue amount of proptosis.

Abscision.—The operation of abscision is now so little practised that the Committee has not elicited anything with regard to its technique, which has not been previously published * for several years. They consider, therefore, that it is unnecessary for them to deal with the matter here. The insertion of a continuous suture passed through the conjunctiva only, the suture *en bourse* of De Wecker, would, they think, be the preferable way in which to close the opening left by the removal of the cornea.

VI. To what Extent should the Choice of Operation depend on the Nature of the Case?

The chief conditions which necessitate excision of the eyeball, or one of the operations which have been substituted for it, may be classified as follows:

1. Intra-ocular malignant growths.
2. Suppurative panophthalmitis.

* 'Treatise on Diseases of the Eye,' Soelberg Wells.

3. Wounds of the eye likely to excite sympathetic ophthalmitis.

4. Anterior staphyloma.

5. Shrunken eyeballs.

6. Painful blind glaucomatous eyeballs.

We will now discuss the suitability of the operations under consideration in each of these different classes of cases.

1. *Intra-ocular malignant growths.*—In a case of intra-ocular malignant growth the only operation suitable is excision of the eyeball. In none of the other operations can the removal of the whole of the growth and the probable freedom from local recurrence be so satisfactorily secured.

2. *Suppurative panophthalmitis.*—In cases of suppurative panophthalmitis, excision seems undoubtedly to involve a risk of fatal meningitis, which, however, is a very infrequent occurrence. It seems probable that none of the alternative operations have been performed with sufficient frequency to allow of its being stated that they are less prone than excision to be followed by this complication.

Fatal meningitis has also occurred after needling of cataract, extraction of cataract, and iridectomy for glaucoma; it might consequently result from the operation of evisceration.

We have already referred to one case in which death from meningitis followed evisceration. (*Vide* Bocci's case, p. 242.)

A patient with panophthalmitis has generally, when the time for operation comes, been suffering acute pain for some days. The operation of excision at once relieves this, while evisceration, in consequence of the reaction which follows, may for a time intensify it.

3. *Wounds of the eye likely to excite sympathetic ophthalmitis.*—We have shown that sympathetic ophthalmitis may set in after all the operations under consideration.

There is no definite proof that any of the operative procedures themselves can excite this disease, though the

possibility of their having done so cannot in some cases be excluded.

In considering the relative immunity afforded by these different operations, we have found that after Mules' operation, optico-ciliary neurotomy, optico-ciliary neurectomy, and abscision, the freedom from sympathetic ophthalmitis has been less than after excision.

With regard to Mules' operation, the facts we have collected seem to show that it is only when it has been delayed until more than three weeks after the receipt of the original injury that sympathetic inflammation is to be feared.

If performed within three weeks of the original injury, and if care be taken to remove entirely the uveal tract, it probably affords as great an immunity as can be obtained by excision.

When sympathetic ophthalmitis has already appeared, the operation of excision should be preferred to evisceration.

In cases of recent injury, when the sclerotic has been much contused or burnt with caustics, excision should be performed, because if the sclerotic is left it is liable to slough.

4. *Anterior staphyloma.*—Cases with disfiguring anterior staphylomata are those best suited for Mules' operation, the eyes being as a rule, at the time of the operation, free from inflammation and not themselves likely to give rise to sympathetic disease.

This is also the class of case in which the operation of abscision has been chiefly practised. Abscision is an operation which the Committee does not recommend, mainly on account of the frequency with which the stump becomes painful and tender, and gives rise to sympathetic irritation in the other eye.

The Committee recognise, however, that in certain countries, and among certain communities whose religious or other scruples are strongly opposed to the idea of removal of the eye, this operation may be of undoubted service.

In a case in which there is an anterior staphyloma in both eyes, if the operation of abscision is performed, the opening being closed by the suture *en bourse* inserted into the conjunctiva, there will be the possibility of preserving perception of light, and at the same time of removing the unsightly disfigurement.

5. *Shrunken eyeballs.*—If a globe is much shrunken the introduction of an artificial globe into the emptied sclerotic is not possible, and excision is the operation that must be resorted to.

6. *Painful blind glaucomatous eyeballs.*—These eyes are not a source of disfigurement to the patient, and as they are not likely to set up sympathetic inflammation, an operation which will remove pain without altering the appearance of the eyeball (or patient) is worthy of consideration.

It is therefore for these cases, if any, that the operations of optico-ciliary neurectomy or neurotomy are best suited. Unfortunately we have already shown that the relief of pain in these cases after optico-ciliary neurectomy is not always permanent.

As such eyes are not likely to set up sympathetic inflammation they are well suited for Mules' operation.

There are certain general conditions besides that of the eyeball which have to be taken into account in the choice of operation, viz. :

1. Age of patient.
2. Condition of patient's general health.
3. Patient's occupation and social status.
4. Patient's surroundings.

1. *Age of the patient.*—It is more important generally to obtain the best possible cosmetic condition in a young patient than in one advanced in life.

As a rule young patients will be found more willing than old ones to endure a prolonged course of treatment, and to suffer a certain amount of pain, for the sake of

their appearance. Hence Mules' operation may be suitable in young people, where in similar cases it is advisable to perform excision in the aged.

2. *Condition of the patient's general health.*—If the patient's health is in any way deteriorated, it is necessary to consider whether the additional shock from excessive reaction, which is likely to follow Mules' operation, may not seriously aggravate his malady. The alternative operation of excision is free from this risk.

3. *Patient's occupation and social status.*—There are many occupations in which an individual would be unable to obtain employment with a conspicuous and unsightly glass eye, and where, consequently, every endeavour should be made to obtain the least possible disfigurement which is compatible with safety. On the other hand, there are occupations in which individuals are much exposed to the risk of blows on the face, and in whom it is not advisable that an artificial globe should be inserted. In certain grades of society the cosmetic result is of greater importance than in others.

4. *Patient's surroundings.*—We have already referred to the religious and other scruples which among certain communities make people absolutely refuse to have the eye removed. In these circumstances, consequently, the operations of abscision or optico-ciliary neurectomy may be suitably performed when, under other conditions, excision or evisceration would be advisable.

In countries also where glass eyes are not easily obtained, or where the people are too poor to be likely to buy and renew them with sufficient frequency, the same course may be necessary, though, as a rule, simple excision with partial union of the lid margins is to be preferred.

W. Adams Frost, *Chairman.*
Arthur H. Benson.
Ernest Clarke.
John Griffith.
Priestley Smith.
E. Treacher Collins, *Hon. Sec.*

APPENDIX TO REPORT.

The following circular letter was sent round by the Committee in May, 1896, to all the members of the Society, and to other ophthalmic surgeons whom it was thought would be able to supply evidence useful in the investigation :

Dear Sir,

I beg to inform you that a Committee has been appointed by the Council to report to this Society on the relative value of Simple Enucleation of the Eyeball, and the operations which have been substituted for it, viz. evisceration with or without the introduction of a globe, insertion of a globe into Tenon's capsule, abscision, optico-ciliary neurectomy, and neurotomy.

The Committee invite you kindly to furnish them with any of your unpublished cases, or reference to published ones which you may consider have any bearing upon the following questions :

1. What are the relative risks of meningitis ?

2. What are the relative risks of sympathetic affections ?

3. What are the other disadvantages, immediate or remote, of the various alternative operations (such as excessive reaction or non-permanence of desired result, &c.) ?

4. What are the special advantages with relation to the wearing of an artificial eye ?

5. Are there any special points to be emphasised in the technique of any of the above operations ?

6. To what extent should the choice of operation depend on the nature of the case ?

It is requested that, if possible, any communications in answer to this letter should be sent in before October 1st.

I am, dear sir,
Yours truly,
E. Treacher Collins,
Secretary to the Committee.

Replies and communications have been received from the following :

T. Anderson (York), J. W. Barrett (Melbourne), T. H. Bickerton (Liverpool), T. Bonar (Rome), A. Bronner (Bradford), J. W. Browne (Belfast), Gordon Byers (London), W. E. Cant (Jerusalem), W. J. Cant (Lincoln), R. W. Carter (Weymouth), W. Charnley (Shrewsbury), Ernest Clarke (London), E. Treacher Collins (London), F. R. Cross (Bristol), E. Donaldson (Londonderry), H. H. Du Boulay (Weymouth), H. L. Ferguson (New Zealand), H. H. Folker (Stoke-on-Trent), E. C. Fischer (London), W. A. Frost (London), Albert Graefe (Halle), A. H. Griffith (Manchester), John Griffith (London), H. Grimsdale (London), G. Hartridge (London), G. Helm (Marazion), L. Howe (Buffalo), R. L. Knaggs (Leeds), A. McGillivray (Dundee), D. N. Maclennan (London), C. D. Marshall (London), P. H. Mules (Whalley Bridge), H. Power (London), A. Prichard (Clifton), N. C. Ridley (Leicester), J. R. Rolston (Plymouth), J. T. Rudall (Melbourne), — Schulek (Buda Pest), C. H. Shears (Liverpool), W. W. Sinclair (Ipswich), Priestley Smith (Birmingham), S. Stephenson (London), H. R. Swanzy (Dublin), T. Pridgin Teale (Leeds), R. Thompson (Brisbane), G. E. Wherry (Cambridge), A. L. Whitehead (Leeds), G. E. Williamson (Newcastle).

Literature bearing on the subject considered has been investigated, and reference to articles quoted or referred to are given in the report.

The following are tables of cases upon which certain statements made in the report are based.

Table of One Hundred and Twenty Cases of Mules' Operation of Evisceration. Compiled by W. Adams Frost *and* H. Grimsdale.

The following abbreviations are used:—In the *Reference* column: G. = St. George's Hospital; W. = Royal Westminster Ophthalmic Hospital; Pr. = Private case. In the *Nature of case* column I. = recent injury; O. = corneal opacity or staphyloma; T. = intra-ocular tumour; Gl. = glaucoma; I. old = old injury; U. = recent perforating ulcer; Cyc. = cyclitis; Cat. = failure of cataract extraction. In the *Operator* column: R. B. C. = R. Brudenell Carter; W. A. F. = W. Adams Frost; H. G. = H. Grimsdale. In the *Result* column: S. = success, *i. e.* sphere completely covered; F. = failure, *i. e.* non-retention of sphere; P. = partial success, *i. e.* sphere exposed in part. The days in hospital are counted from the operation.

No	Name.	Age.	Reference.	Nature of case.	Operator.	Result.	Details.
1	M. M.	9	851 G, 1886	I.	R. B. C.	S.	Wound of lens; suction 3 weeks; Mules' 5 weeks after accident; a month later condition satisfactory.
2	E. C.	5	359 G, 1886	I.	R. B. C.	S.	Traumatic cataract; suction; suppuration; Mules' a month after accident; condition satisfactory 4 years later.
3	F. C.	15	1778 G, 1886	I.	R. B. C.	S.	Eye blind 4 to 5 years; cause not stated.
4	W. T.	15 mos.	1935 G, 1886	I.	W. A. F.	F.	Wound with scissors 4 months before operation; sphere escaped on 7th day.
5	W. R.	35	2018 G, 1886	I.	W. A. F.	F.	Wound; prolapsed iris excised; hypopyon; Mules' a month after accident; sphere escaped 3rd day.
6	K. C.	14	410 G, 1887	O.	W. A. F.	F.	Old corneal opacity; sphere became exposed 4 mm.; plastic operation failed; smaller sphere substituted 8 weeks after Mules'; not retained.
7	A. R.	10	621 G, 1887	O.	W. A. F.	S.	Old opacity of cornea.
8	E. S.	22	1005 G, 1887	?	R. B. C.	S.	Eye long blind; cause not stated; did well; only 11 days in hospital.
9	B. C.	24	1193 G, 1887	I.	R. B. C.	F.	Wound with glass 2 days; much reaction, and sphere escaped 10th day.
10	C. B.	34	1303 G, 1887	I.	W. A. F.	S.	Contusion of a blind eye 5 days; did well; in hospital 14 days.
11	J. M.	8 mos.	1528 G, 1887	T.	W. A. F.	S.	Diagnosed as intra-ocular tumour; no record of the microscopical examination; sutures removed 7 days; in hospital 14 days.
12	M. P.	64	1556 G, 1887	Gl.	W. A. F.	S.	Glaucoma; intra-ocular hæmorrhage; sutures 7 days; in hospital 17 days.

							after accident; sutures 10 days; patient in weak health; in hospital 28 days after operation.
14	C. A.	32	1275 G, 1888	O.	R. B. C.	F.	Old corneal opacity; sphere escaped 13th day.
15	J. H.	21	263 G, 1888	I.	W. A. F.	S.	Corneal wound and loss of vitreous; Mules' 12 days later; sutures 9 and 12 days; good stump 2½ years.
16	G. E.	38	481 G, 1888	I.	W. A. F.	F.	Wound of cornea and lens; excision of prolapsed iris; suppurative panophthalmitis; Mules' 16 days after accident; tissues thickened; traction on sutures; sphere escaped 6th day.
17	A. R.	63	622 G, 1888	Gl.	R. B. C.	F.	Old glaucoma; centre of wound not healed; plastic operation failed; returned 4½ years later with sphere exposed, one third full of pus, and minute opening in centre of it; sphere removed.
18	A. M.	14	138 G, 1888	I.	W. A. F.	F.	Wound of cornea; suppuration; Mules' 7 days; sutures 7 days; sphere exposed 11 days after operation; smaller sphere substituted; latter escaped during attack of scarlet fever.
19	J. D.	16	895 G, 1888	O.	R. B. C.	S.	Staphyloma of cornea; free hæmorrhage after operation; sutures 7 days.
20	J. F.	27	1085 G, 1888	O.	W. A. F.	S.	Operations for lamellar cataract, followed by cyclitis and ciliary staphyloma; satisfactory 6 months later.
21	A. P.	39	1195 G, 1888	O.	R. B. C.	S.	Old corneal opacity; posterior synechiæ.
22	C. C.	12	1705 W, 1888	I.	W. A. F.	S.	Perforating wound.
23	G. H.	19	1764 G, 1888	O.	W. A. F.	S.	Blow 10 years previously, followed by cataract, which had been operated on elsewhere without success; cornea staphylomatous; sutures 8 days.
24	M. D.	21	1465 G, 1888	O.	R. B.C.	S.	Corneal opacity and calcareous lens.
25	M. H.	5	1743 G, 1888	T.	R. B. C.	S.	Glioma of retina; confirmed by report of pathologist; sutures 7 days; in hospital 14 days.
26	J. M.	24	1387 G, 1888	I.	R. B. C.	S.	Wound of cornea; Mules' 15 days later; sutures 7th day.
27	C. M.	19	1805 G, 1888	O.	W. A. F.	S.	Burn by lime 8 years; cornea opaque; sutures 6 days.
28	J. M.	42	1886 G, 1888	I.	W. A F.	F.	Wound of cornea 5 weeks; hypopyon; sphere escaped 7th day.
29	H. H.	8	870 G, 1888	I. old	W. A. F.	S.	Wound with prolapse of iris; blood in vitreous; eye quieted, but 6 months after accident painful and tender, flushing on exposure; sutures 7 days.
30	A. H.	54	2025 G, 1888	I. old	R. B. C.	S.	Wound 8 years previously; eye occasionally painful; cornea opaque; sutures 8 days; artificial eye 6 weeks.

No.	Name.	Age.	Reference.	Nature of case.	Operator.	Result.	Details.
31	W. B.	51	130 G, 1889	I.	W. A. F.	F.	Wound; hypopyon; sloughing of cornea; Mules' 2 months after accident; choroid thickened; scooped out with difficulty; sphere removed 6th day; sclerotic partially sloughed, and came away slowly.
32	C. W.	12	908 G, 1889	O.	W. A. F.	F.	Shrunken globe, probably from ophthalmia neonatorum; sutures 8 days; union not firm; wound gaped later; sphere escaped 4 weeks.
33	C. L.	7	W, 1889	O.	W. A. F.	S.	Shrunken globe.
34	J. N.	50	897 G, 1889	I.	W. A. F.	S.	Rupture of globe; Mules' within 24 hours; sutures 9th day; artificial eye 3 weeks.
35	F. D.	22	259 G, 1889	I.	W. A. F.	F.	Rupture of globe 2 days; sphere escaped 8th day.
36	M. J.	26	W, 1889	—	W. A. F.	S.	Old injury.
37	J. P.	16	1043 W, 1889	—	W. A. F.	F.	Notes imperfect; sphere escaped.
38	W. B.	21	156 G, 1890	I.	W. A. F.	F.	Wound; prolapsed iris excised; suppuration threatening; Mules' 19th day; piece of iron found in vitreous; sphere escaped 10th day; reaction was excessive.
39	C. K.	32	392 G, 1890	I.	R. B. C.	S.	Contusion; intra-ocular hæmorrhage; Mules' 11 days; in hospital 18 days.
40	L. M.	9	7 G, 1890	O.	R. B. C.	S.	Old corneal opacity and iridectomy; recent inflammation and increased tension; yellow reflex from vitreous; pus found in vitreous; sutures 7th and 12th days; in hospital 18 days; seen 4 years later; good stump; artificial eye ordered for first time.
41	J. B.	3½	1182 G, 1890	O.	W. A. F.	F.	Opacity from ophthalmia neonatorum; hæmorrhage day after operation; sphere escaped.
42	T. G.	37	1192 G, 1890	I.	R. B. C.	F.	Wound of cornea 27 days; more hæmorrhage than usual; sutures 8th day; sphere exposed; removed 12th day.
43	F. H.	—	2189 G, 1890	I.	R. B. C.	S.	Punctured wound 4 days; pus found in globe; sutures 7th day; in hospital 10 days; reaction slight; satisfactory 4 years later.
44	H. H.	21	57 G, 1891	I.	W. A. F.	S.	Wound; Mules' 8th day; pus in vitreous; sphere escaped 12th day.
45	E. M.	3	59 W, 1891	O.	W. A. F.	F.	Corneal staphyloma; sphere escaped.
46	R. R.	23	1039 G, 1891	I.	W. A. F.	S.	Wound; prolapsed iris excised; improved, then relapse;

							hospital 23 days.
48	M. P.	1½	1081 G, 1891	I.	W. A. F.	F.	Wound with loss of vitreous; Mules' 5th day; sphere escaped.
49	W. —	14	88 G, 1891	O.	R. B. C.	S.	Adherent leucoma; shrunken globe; sutures 7th day; in hospital 14 days.
50	A. N.	10	579 G, 1891	O.	W. A. F.	S.	Corneal staphyloma after ophthalmia neonatorum; sutures 14th day; in hospital 15 days.
51	G. T.	43	1386 G, 1891	O.	W. A. F.	S.	Old corneal staphyloma; in hospital 14 days.
52	S. L.	19	1424 G, 1891	I.	W. A. F.	F.	Perforating and contused wound; Mules' 3rd day; sutures 7 days; sphere escaped 14th day; good stump.
53	A. G.	14	W, 1891	I.	W. A. F.	S.	Wound in ciliary region; satisfactory 6 months.
54	F. N.	20	71 W, 1892	O.	W. A. F.	S.	Corneal staphyloma.
55	J. M.	24	206 G, 1892	U.	R. B. C.	S.	Gonorrhœal ophthalmia; perforating ulcer; Mules' 16 days after perforation; sutures 7th day; in hospital 25 days; satisfactory 3 years later.
56	T. B.	35	135 G, 1892	I.	R. B. C.	S.	Contusion without wound 6 weeks, then pain and increased tension; Mules'; much conjunctival swelling followed; sutures 13th day; in hospital 21 days.
57	C. S.	3½	75 G, 1893	O.	W. A. F.	S.	Injury when a year old, followed by corneal and ciliary staphyloma; sutures 7th day.
58	H. G.	33	171 G, 1893	I.	W. A. F.	S.	Wound with f. b. in vitreous; Mules' 3rd day; sutures 12th day; in hospital 28 days.
59	G. W.	10	312 G, 1893	I.	W. A. F.	S.	Wound; prolapse of iris and cataract; iridectomy and expression of lens; hypopyon; Mules'; sutures 9th and 12th days; satisfactory 2 years later.
60	H. H.	14	449 G, 1893	I.	W. A. F.	S.	Contusion; lens dislocated into vitreous; blood in a.c.; opacities in vitreous; probably detached retina; Mules' 42 days; sutures 7th day; satisfactory a year later.
61	A. F.	20	446 W, 1893	U.	W. A. F.	S.	Purulent ophthalmia; sloughing of cornea.
62	M. H.	21	995 G, 1893	?	W. A. F.	S.	Blind eye; cause not stated; sutures 9th day; in hospital 11 days.
63	A. S.	13	1106 G, 1893	I.	W. A. F.	S.	Wound; suppurative panophthalmitis; sutures 7th day; in hospital 13 days.
64	J. P.	14	1051 G, 1893	I.	W. A. F.	F.	Wound; eye full of blood; Mules' 24 hours; sutures 8th day; centre not united; sphere escaped 12th day.
65	E. A.	18	1807 G, 1893	I.	W. A. F.	S.	Wound; loss of vitreous; Mules' 22 hours; sutures 10th day; satisfactory a year later.

No.	Name.	Age.	Reference.	Nature of case.	Operator.	Result.	Details.
66	E. W.	43	1495 G, 1893	?	W. A. F.	S.	Eye blind many years; lens opaque; some ciliary injection; sphere smaller than usual; sutures 9th day; in hospital 21 days; satisfactory 1½ years later.
67	A. C.	25	W, 1894	O.	W. A. F.	S.	Eye lost from purulent ophthalmia; satisfactory 2 years later.
68	M. C.	25	600 G, 1894	—	W. A. F.	F.	Wound; Mules' 24 hours; sphere exposed; plastic operation failed; sphere not known to have escaped, but case counted as a failure.
69	H. L.	29	795 W, 1894	I.	W. A. F.	F.	Injury; sphere escaped.
70	H. S.	29	2110 G, 1894	O.	W. A. F.	S.	Staphyloma of cornea; much reaction; in hospital 21 days.
71	J. B.	14	W, 1895	—	W. A. F.	S.	Satisfactory 5 months later; in hospital 20 days.
72	— J.	5	1145 G, 1895	I.	H. G.	S.	Wound followed by suppuration in vitreous.
73	G. T.	19	W. A. F., pr.	Cyc.	W. A. F.	F.	Cyclitis and opacities in vitreous; reaction slight; sutures 7th day; wound gaped, and suture reintroduced same day; wound again gaped; sphere removed.
74	E. B.	14	G, 1887	O.	R. B. C.	S.	Old keratitis and cyclitis; globe enlarged; attacked with scarlet fever a week after Mules'; wound healed well; satisfactory 9 years later.
75	B. L.	27	354 G, 1895	O.	W. A. F.	S.	Staphyloma of cornea; in hospital 21 days.
76	A. E.	22	364 G, 1895	Cyc.	W. A. F.	F.	Cyclitis; sphere escaped.
77	R. M.	57	180 G, 1895	U.	W. A. F.	P.	Perforating ulcer; left hospital with opening 3 mm. diameter; final result unknown; counted as partial success.
78	A. H.	8	1043 G, 1896	—	W. A. F.	S.	Ciliary staphyloma; cornea vascular; in hospital 22 days.
79	M. F.	32	1234 G, 1896	O.	H. G.	P.	Staphyloma of cornea; partial success.
80	I. K.	5	W. A. F., pr.	O.	W. A. F.	S.	Wound; Mules' 8 months later; satisfactory 4 years later.
81	I. B.	57	2025 G, 1885	I.	W. A. F.	S.	Glaucoma; iridectomy followed by suppuration; small opening remained after Mules'; two plastic operations failed, then wound healed spontaneously.
82	— W.	15	1247 G, 1886	I.	W. A. F.	F.	Recent injury; sphere escaped.
83	W. K.	50	1446 G, 1887	Cat.	R. B. C.	F.	Cataract operation; sphere escaped.
84	J. H.	48	G, 1896	Gl.	W. A. F.	S.	Old absolute glaucoma.
85	H. T.	29	229 G, 1891	I.	W. A. F.	S.	Rupture of globe; in hospital 21 days.
86	H. D.	20	341 G, 1893	O.	W. A. F.	S.	Old injury; foreign body found in vitreous; in hospital 14 days.

88	E. P.	7	W. A. F., pr. 1888	I.	W. A. F.	S.	Recent injury; sphere appeared to be exposed for a week, then the wound healed; satisfactory 4 months later.
89	G. C.	10	W. A. F., pr. 1888	I.	W. A. F.	S.	Gunpowder explosion, followed by sloughing of cornea; Mules' 2 months after accident; 2 years later granulation tissue sprouting from upper *cul-de-sac* excised; satisfactory 6 years after Mules'.
90	M. S.	12	W. A. F., pr. 1888	Cyc.	W. A. F.	S.	Traumatic cataract; needling and suction operations, followed by enlargement of globe; no p. l., and appearance as in old glaucoma (cyclitis); Mules' 4½ years after needling; satisfactory 8 months later.
91	— C.	6	W. A. F., pr. 1892	O.	W. A. F.	F.	Staphyloma from ophthalmia neonatorum; sutures 11th day; wound seemed healed, but gaped next day; plastic operation failed; a month after first operation smaller sphere substituted, but wound did not unite; very delicate child.
92	— J.	21	G, 1892	U.	W. A. F.	S.	Gonorrhœal ophthalmia.
93	J. B.	31	—	Cat.	W. A. F.	S.	Lamellar cataract; suppurated after operation; Mules'; no swelling; in hospital 28 days.
94	L. G.	7	1359 G, 1894	O.	W. A. F.	S.	Corneal staphyloma; in hospital 10 days.
95	A. L.	26	927 G, 1894	O.	W. A. F.	S.	Old conical cornea; trephining followed by ciliary staphyloma; in hospital 14 days.
96	E. T.	9	1379 G, 1896	I.	W. A. F.	S.	Recent injury; satisfactory 3 months later.
97	C. F.	54	G, 1896	I.	W. A. F.	S.	Lacerated wound of sclerotic 14 days.
98	— G.	58	W, 1894	I.	W. A. F.	F.	Injury; sphere escaped.
99	— T.	37	W, 1894	I.	W. A. F.	S.	Wound of lids and globe; eyelids stitched together; satisfactory 18 months later.
100	— F.	6	W, 1894	I.	W. A. F.	S.	Wound with needle.
101	H. S.	16	G, 1897	I.	W. A. F.	S.	Injury 6 weeks; lead pellet found.
102	A. H.	11	1775 G, 1896	—	W. A. F.	S.	Suppuration after needling.
103	W. L.	15	1871 G, 1896	I.	W. A. F.	S.	Recent wound, with retained foreign body (copper cap).
104	H. S.	54	202 G, 1897	U.	H. G.	S.	Perforating ulcer.
105	J. E.	39	281 G, 1897	I.	W. A. F.	S.	Recent injury, with retained foreign body.
106	E. L.	21	241 G, 1897	I. old	W. A. F.	S.	Old injury.
107	M. W.	40	304 G, 1897	—	W. A. F.	F.	Panophthalmitis.
108	E. W.	34	364 G, 1897	I.	H. G.	F.	Ruptured globe; patient very restless.
109	M. B.	52	472 G, 1897	T.	H. G.	F.	Hypopyon ulcer; globe full of new growth, sarcoma; no recurrence 6 months.
110	R. V.	38	330 G, 1897	I.	H. G.	F.	Ruptured globe.
111	J. D.	11 mos.	745 G, 1897	O.	W. A. F.	S.	Staphyloma after ophthalmia neonatorum.

No.	Name.	Age.	Reference.	Nature of case.	Operator.	Result.	Details.
112	J. M.	20	G, 1897	I.	W. A. F.	F.	Recent lacerated wound; sphere incompletely covered on removing sutures.
113	J. G.	56	1455 G, 1897	U.	W. A. F.	S.	Perforating ulcer; sphere exposed on 7th day; wound eventually healed.
114	N. S.	7	1343 G, 1897	I.	W. A. F.	F.	Wound of cornea and retained foreign body; suppuration; very large sphere used; plastic operation failed.
115	J. H.	16	1135 W, 1897	I.	H. G.	S.	Globe ruptured and collapsed.
116	J. D.	9	W, 1897	I. old	W. A. F.	S.	First seen in 1892; blind from old injury; operation on account of pain.
117	F. W.	10	W, 1897	—	W. A. F.	S.	Suppuration after needling for lamellar cataract.
118	R. B.	12	W, 1897	I.	W. A. F.	F.	Large lacerated wound.
119	L. B.	13	W, 1896	O.	W. A. F.	S.	Leucoma of cornea.
120	Mr. M.	25	W. A. F., pr. 1897	I.	W. A. F.	S.	Perforating wound from glass 3 days.

Table of Twenty Mules' Operations (selected out of a Total of Fifty Cases) performed by T. H. BICKERTON, *in which the Globe was extruded, or in which there was some special point of interest.*

No.	Name.	Age.	Nature of case.	History subsequent to operation.
1	F. M.	14	Wound in ciliary region with rusty nail	Operation followed by very great swelling of lids; temp. 102·4° on 2nd day; protrusion of conjunctiva between lids on 3rd; on 10th day glass sphere came out and sclerotic noted to have sloughed *en masse;* on 11th day the necrosed sclerotic came away entire, showing the circular aperture of the optic nerve.
2	T. L.	54	Suppurative panophthalmitis after injury with molten brass	Considerable pain on day following operation; temp. 100°; considerable swelling of lids increased until 4th day; on 8th day allowed up; on 9th day silver sphere escaped; sclerotic white and apparently necrosed. During the ensuing 3 months it gradually sloughed away. Discharged from hospital on 25th day.
3	M. B.	19	Ulcerating staphylomatous cornea in strumous subject	Constant retching and vomiting for several days after operation; swelling considerable, extending to cheek; great pain; on 6th day patient allowed up; on 7th day glass globe escaped.
4	H. B.	59	Painful glaucomatous eye; alcoholic subject	A single continuous suture used for sclerotic and conjunctiva; globe extruded on 8th day.
5	M. T.	21	Corneo-scleral wound; patient suffering from general malnutrition	Globe extruded on 14th day.
6	R. W.	53	Glaucomatous painful blind eye in a patient the subject of locomotor ataxia	Vomiting for 8 hours after operation; scarcely any swelling of eyelids; slight protrusion of œdematous conjunctiva; globe exposed on 12th day and extruded on the 23rd.

No.	Name.	Age.	Nature of case.	History subsequent to operation.
7	M. H.	7	Wound in ciliary region	Reaction slight. Patient discharged from hospital with a good stump and firmly healed cicatrix. Three weeks after operation artificial eye supplied, which was worn continuously, often for more than a week at a time, provoking much irritation. About 8 months after operation small central aperture in cicatrix noticed, which increased in size until glass globe was extruded.
8	E. M.	29	Old injured blind eye with irido-cyclitis in a patient of intemperate habits	Reaction slight; swelling greatest on 2nd day. Patient left hospital on 14th day; 38 days after operation silver ball seen through aperture in cicatrix; 24 days later patient returned with sphere lying free in orbit.
9	J. W.	54	Old injured, blind, painful eye	Swelling very considerable; greatest on 4th day, extending to side of face and across to upper lid of the other eye. A minute opening noticed in cicatrix three months after operation; this increased to size of a sixpenny piece, and remained so for 3 months, when on account of pain the glass ball was removed.
10 (recorded in Brit. Med. Journ., Sept., 1896, p. 815, Case 7)	A. M.	32	Wounded eye; fragment of steel in it	Swelling of lids and conjunctiva greatest on the 4th day. A minute aperture in cicatrix noted 35 days after the operation, which closed up 7 days later without anything being done. Has worn artificial eye for a year with no inconvenience whatever; cosmetic result and movement admirable.
11	P. G.	60	Wound of eye with a nail	Greatest swelling of lids on 2nd day. Left hospital on 12th day. Final cosmetic result and movement admirable.
12 (recorded in Brit. Med. Journ., Sept., 1896, p. 815, Case 5)	O. F.	27	Painful anterior staphyloma	Reaction and after-pain slight. Discharged from hospital on 15th day. Final result admirable.
13 (recorded in Brit. Med. Journ., Sept., 1896,	L. B.	27	Blind eye after unsuccessful cataract operation; sympathetic irritation of fellow eye	Pain very severe for 24 hours, and swelling very great. Went out on the 10th day. Artificial eye fitted 10 weeks after operation. Five years later stump in perfect condition, and movement admirable.

14 (recorded in Brit. Med. Journ., Sept., 1896, p. 814, Case 2)	J. R.	20	Wound in ciliary region; sympathetic irritation of fellow eye	Pain, swelling, redness, and [illegible]; hospital 15 days. Operation in 1892; condition since then has been admirable.
15 (recorded in Brit. Med. Journ., Sept., 1896, p. 814, Case 3)	J. C.	45	Blind painful eye with dislocated lens	Ice-pad after treatment; reaction not excessive; healing rapid and perfect. Cosmetic effect and movement admirable.
16 (recorded in Brit. Med. Journ., Sept., 1896, p. 815	I. P.	53	Inflamed blind eye	Ice-pad after treatment; pain severe; swelling and œdema of conjunctiva great. Subsequent cosmetic effect and movement admirable.
17 (recorded in Brit. Med. Journ., Sept., 1896, p. 815, Case 6)	R. K.	13	Wound of cornea and lens	Ice-pad after treatment; reaction very slight. Cosmetic effect and movements of artificial eye admirable.
18	J. W.	28	Shrinking after wound with a piece of steel	Unavoidable traction made on optic nerve during operation in removing silver globe first inserted, which was too large. Vomiting and nausea for 4 days after operation; much swelling of lids, most on the 3rd day. Patient left hospital 9 days after operation with a good moveable stump.
19	C. H.	60	Painful blind glaucomatous eye	Ice-pad after treatment; very little reaction. Patient left hospital 13 days after operation with a firm cicatrix and good moveable stump. Six months later a tiny pin-point aperture in sclerotic noted, exposing silver globe with argyriosis of stump.
20	J. B.	45	Extensive corneo-scleral wound; a piece of steel weighing 9 grains found in the eye	Operation 21 days after injury; local and general febrile reaction slight. Left hospital on 11th day with firm stump and good movement. 25 days after operation returned with complete ring synechia; sympathetic iritis; synechia completely broken down by atropine pushed to toxic limit; restoration of perfect vision in 10 days (15 months later, vision perfect and Mules' stump excellent).

Table of Forty Cases of Excision of the Eye in which an Artificial Globe was afterwards inserted into Tenon's Capsule, operated on by Lang at the Moorfields Hospital. Compiled by E. TREACHER COLLINS.

No.	Name.	Age.	Reference.	Nature of case.	Nature of artificial globe inserted.	Progress of case and number of days in hospital after operation.	Result.
1	B. C.	35	1435, 1886	Ulcer of cornea, with hypopyon	Glass	10 days	Four years and five months later globe *in situ*. Stump of good shape and freely moveable. No artificial eye had been worn.
2	W. C.	29	1439, 1886	Blind painful eye, with leucoma of cornea	„	22 days	Later history unknown.
3	J. G.	21	1440, 1886	Shrunken eyeball	„	Glass globe escaped 6 days after operation	—
4	G. G.	5½	1520, 1886	Anterior staphyloma	„	16 days	Ten and a half years later globe *in situ* and in centre of orbit. Stump freely moveable. Artificial eye worn regularly since operation. Movement of artificial eye vertically very good; lateral movement very limited.
5	M. A. H.	28	1671, 1886	Shrunken eyeball	„	Sickness, and swelling of lids; 31 days	Later history unknown.
6	E. B.	33	1742, 1886	Wounded eye	„	Much swelling of lids; 9 days	„
7	E. B.	15	109, 1887	„	„	10 days	Ten and a quarter years later globe found somewhat displaced upwards. Not much movement in stump, but artificial eye did not appear sunken.
8	M. B.	23	144, 1887	Leucoma adherens	„	9 days	Ten years later globe *in situ* and in centre of orbit. Artificial eye worn regularly since operation; vertical movement in it more extensive than lateral.

9	J. R.	19	152, 1887	—	„	9 days after operation	
10	G. H.	25	181, 1887	Anterior staphyloma	„	Detained in hospital for operation on the other eye	—
11	E. M.	4	397, 1887	„	„	4 days	Later history unknown.
12	W. G.	49	215, 1887	Sarcoma of choroid	„	6 days	Attended later as an out-patient with abscess in orbit, and was afterwards in Guy's Hospital with secondary growths in liver. No note of escape of globe.
13	J. Q.	33	419, 1887	Foreign body in eye, sympathetic ophthalmitis in the other	„	27 days	Globe removed by another surgeon soon after on account of pain and the progressive character of the sympathetic disease.
14	E. S.	5	539, 1887	Shrunken eyeball	„	6 days	Later history unknown.
15	G. C.	41	598, 1887	Wounded eye	Silver	Silver globe escaped 6 days after operation	—
16	E. R.	32	709, 1887	„	Celluloid	7 days	Later history unknown.
17	J. R.	74	778, 1887	Glaucoma	„	6 days	„
18	K. O.	5½	881, 1887	Anterior staphyloma	„	6 days	„
19	L. G.	10	927, 1887	Shrunken eyeball	„	Celluloid globe escaped 3 days after operation	—
20	J. S.	73	941, 1887	Wounded eye	„	7 days	Later history unknown.
21	H. W.	64	989, 1887	„	„	Considerable swelling of conjunctiva in lower fornix noted five days after operation; 6 days	„
22	G. B.	47	1062, 1887	„	Glass	7 days	„
23	A. N.	46	1297, 1887	Escape of vitreous, &c., after removal of dislocated lens	Celluloid	Considerable ecchymosis of lids; 9 days	„
24	J. C.	72	1324, 1887	Absolute glaucoma	Glass	Considerable ecchymosis of lids and swelling; 7 days	„

No.	Name.	Age.	Reference.	Nature of case.	Nature of artificial globe inserted.	Progress of case and number of days in hospital after operation.	Result.
25	F. N.	6	1384, 1887	Ulcer of cornea and hypopyon	Celluloid	Celluloid globe escaped 5 days later	—
26	Ch. W. B.	39	1408, 1887	Sarcoma of choroid	Glass	4 days	Later history unknown.
27	G. T.	49	1411, 1887	Wounded eye	,,	,,	,,
28	E. E.	1 year 7 mos.	1415, 1887	Glioma of retina	,,	6 days	,,
29	A. I.	6	1472, 1887	Wounded eye	,,	4 days	,,
30	H. W.	4	1491, 1887	,,	,,	,,	,,
31	E. S.	42	1585, 1887	Ruptured globe	,,	7 days	,,
32	L. B.	14	1750, 1887	Wounded eye	Celluloid	4 days	,,
33	N. M.	32	1771, 1887	,,	,,	7 days	,,
34	E. P.	7	1801, 1887	Shrunken eyeball	Glass	6 days	Nine years and three months later globe *in situ* in centre of orbit. Good movement of stump. Vertical movements of artificial eye good. Lateral movements very limited.
35	E. L.	36	1966, 1887	,,	Celluloid	7 days	Later history unknown.
36	E. C.	5	1976, 1887	Anterior staphyloma	,,	Celluloid globe escaped 9 days after operation	—
37	M. A. N.	18	2042, 1887	Adherent leucoma	Glass	5 days	Glass globe escaped 6 weeks after removal of eyeball.
38	C. A.	21	1229, 1888	Shrunken eyeball	,,	Detained in hospital for affection of other eye	Later history unknown.
39	W. J. C.	30	1673, 1888	Wounded eye	,,	3 days	,,
40	V. K.	$2\frac{3}{4}$	171, 1889	Pseudo-glioma	,,	4 days	Eight years later globe *in situ*, but displaced towards the outer side of orbit. No artificial eye worn.

Table showing the Measurements of the Orifice of the Orbits on the two sides in Cases in which an Eyeball had been Removed early in Life, and several years had since elapsed. By GORDON BYERS.

No.	Sex.	Age at date of operation.	Age at date of measurement.	Eye excised.	Vertical measurement of orbit.		Transverse measurement of orbit.	
					Right.	Left.	Right.	Left.
1	M.	4	19	R.	3·5 cm.	3·5 cm.	3·5 cm.	3·6 cm.
2	M.	11½	21	R.	3·6 „	3·6 „	3·6 „	3·5 „
3	F.	10	24	L.	3·4 „	3·3 „	3·6 „	3·6 „
4	M.	11	25	R.	3·7 „	3·7 „	3·9 „	4·0 „
5	F.	11	25	L.	3·0 „	2·9 „	3·3 „	3·3 „
6	M.	2	24	R.	3·1 „	3·2 „	3·5 „	3·5 „
7	M.	3	25	R.	3·5 „	3·4 „	3·9 „	3·9 „
8	M.	13	43	R.	3·0 „	3·0 „	3·5 „	3·3 „
9	F.	4	39	L.	3·2 „	3·2 „	3·5 „	3·2 „
10	M.	1¼	29	R.	3·4 „	3·8 „	3·5 „	3·7 „

June 24th, 1898.

To the Secretary of the Committee on Evisceration.

Dear Sir,—I much regret being unable to sign the Report as a whole, owing to my disagreement with the conclusions arrived at in regard to Question VI, which appears to me to be the most important section of the inquiry, involving as it does the vital considerations of meningitis and sympathetic inflammation. I cannot help feeling that in this section of the report—

(*a*) Excision appears to be too strongly advocated to the limitation of the more conservative procedures; and

(*b*) The claims of simple evisceration do not appear to be sufficiently recognised and emphasised.

With the first sixty pages of the Report I am in practical agreement, and, even with the slight reservations I pointed out, would gladly have signed it; but on the question of "the choice of operation" in regard to "the nature of the case," the Report does not embody the opinions expressed in my evidence to the Committee.

My opinion, as the outcome of personal experience and conviction, is in accordance with the principles applied to surgical disease elsewhere, viz.: "that when a diseased portion of the human body must be removed, the surgeon should not remove more than is absolutely necessary," and I thus cannot support the classical operation of excision in the majority of cases in which its practice is opposed to this fundamental principle of conservative surgery.

In response to your kind request that I should frame a minority report, I herewith forward one, which I have based, for the sake of contrast, on the lines you have followed in the majority report. I have not scrupled to copy those sentences with which I am in agreement, and have indicated such by including them in inverted commas.

Yours faithfully,

Thomas H. Bickerton.

VI. To what Extent should the Choice of Operation Depend on the Nature of the Case?

"The chief conditions which necessitate excision of the eyeball, or one of the operations which have been substituted for it, may be classified as follows:

"1. Intra-ocular malignant growths.

"2. Suppurative panophthalmitis.

"3. Wounds of the eye likely to excite sympathetic ophthalmitis.

"4. Anterior staphyloma.

"5. Shrunken eyeballs.

"6. Painful blind glaucomatous eyeballs."

As of the alternative procedures to excision I have not practised (*a*) abscision, (*b*) optico-ciliary neurotomy, and (*c*) optico-ciliary neurectomy, my remarks are concerned solely with the consideration of excision *versus* simple evisceration and Mules' operation.

In accordance with the general principles of conservative surgery, and the experience of practice, *excision* is only necessary in, and its adoption should be strictly limited to—

(*a*) Intra-ocular malignant growths and orbital malignant growths.

(*b*) Extensively lacerated or contused wounds of the sclerotic.

(*c*) Shrunken globes in which the uveal tract cannot be removed.

(*d*) Cases where sympathetic disease has already been excited.

In *all* other cases, *evisceration*, with or without the insertion of a sphere, is the embodiment of the above principle, and while respecting the moral, religious, and physical scruples of the patient, amply fulfils the pathological requirements of each case.

I will now discuss the suitability of these operations by

applying this general expression to the classes of cases above enumerated.

1. *Intra-ocular malignant growths.*—"In a case of intra-ocular malignant growth the only operation suitable is excision of the eyeball. In none of the other operations can the removal of the whole of the growth and the probable freedom from local recurrence be so satisfactorily secured."

2. *Suppurative panophthalmitis.*—In such cases, evisceration is the most rational operation on the following grounds:

(*a*) Suppurative panophthalmitis is a localised purulent collection in a special organ. In general surgery an abscess is incised and evacuated—not removed *en masse*. In this special case this general principle should be adhered to, for the dense sac wall (sclerotic) is a protective against septic infection of the surrounding tissues.

(*b*) In the absence of statistics to the contrary, excision, on anatomical grounds, by opening up freely the lymphatic and cellular spaces of the orbit, must be more liable than simple evisceration to excite septic meningitis.

"In cases of suppurative panophthalmitis, excision seems undoubtedly to involve a risk of fatal meningitis, which, however, is a very infrequent occurrence."

(*c*) Pain in inflammation is due to tension, and in suppurative panophthalmitis is intense owing to the fibrous non-yielding envelope. In general surgery, incision by abolishing tension relieves pain, and applied to the eye, as in simple evisceration, gives immediate relief.

3. *Wounds of the eye likely to excite sympathetic ophthalmia.*—(With the conclusions arrived at by the Committee under this heading I am in full agreement, but would amplify them as follows.) In all cases of wounds of the eye except (*a*) where sympathetic inflammation has already been excited, (*b*) where the sclerotic is extensively lacerated or contused, Mules' operation or simple eviscera-

tion is the rational operation on the general grounds before indicated.

4. *Anterior staphyloma.*—In this class of cases (as in Class VI) Mules' operation should be performed, in preference to excision in Christian countries, for the following reasons:

(*a*) The general grounds before indicated apply with particular force.

(*b*) As the tissues generally are at the time of operation free from inflammation, firm union can with confidence be looked for. The statistics of actual practice confirm this expectation.

(*c*) As operation is often called for on cosmetic grounds alone, and excision inflicts a positive disfigurement, *that* radical operation ensuring the best cosmetic result should be adopted.

(*d*) Even where the sphere subsequently escapes, the case is converted into one of simple evisceration, and a good support for an artificial eye remains.

In those countries where religious convictions are opposed to removal of the eye, Mules' operation or simple evisceration may in practice be found sufficient to meet these scruples.

Webster Fox's operation of implantation of a glass ball in the orbit after remote enucleation of the eyeball.—In those cases where excision has been practised at some prior date, and where, even with the artificial eye *in situ*, enophthalmitis is pronounced, the personal appearance of the patient may be vastly improved by incising and dissecting up the conjunctiva, and implanting in the pouch thus formed a glass sphere.

5. *Shrunken eyeballs.*—If an eyeball "is much shrunken, the introduction of an artificial globe into the emptied sclerotic is not possible." If in such case the uveal tract can be perfectly and easily removed, simple evisceration should be performed. If the uveal tract cannot be perfectly and easily removed, then excision must be performed.

6. *Painful blind glaucomatous eyes.*—(The statements under this heading express my views.)

General conditions.—With the exception of those cases imperatively demanding excision under all circumstances, no considerations of age, sex, occupation, or social status should militate against evisceration with or without the insertion of a sphere, while simple evisceration is called for in debilitated and senile patients, as its performance is more rapid and involves less shock than excision or Mules' operation.

When evisceration meets all pathological requirements, every age, occupation, or social status demands that operation which, while inflicting the least mutilation, gives the best cosmetic result.

Adams Frost's operation.—In all cases where excision is demanded, the insertion of a glass sphere into the Tenonian cavity (Adams Frost's operation, is to be recommended) except where the operation is done for malignant disease.

THOMAS H. BICKERTON.

XI. MISCELLANEOUS.[1]

1. *Some experiments on the union of corneal wounds.*

By Ernest Clarke.

Mr. President and Gentlemen,—I must express my thanks to the authorities at the laboratories of the Royal College of Physicians and the Royal College of Surgeons for not only affording me the opportunity of conducting this inquiry, but also for granting me permission to read this paper.

The object of these experiments was to ascertain the time taken by corneal wounds in uniting sufficiently to allow the anterior chamber to be re-formed. The operations were performed on the eyes of rabbits and guinea-pigs, under an anæsthetic and with strict antiseptic precautions.

I soon found that the eyes of the guinea-pig were so inferior, for my purpose, to those of the rabbit, owing to their small size, that I confined all my later experiments to the latter animal.

In some experiments the animal was kept under the anæsthetic until killed, while in others it was allowed to recover, and after a varying interval again made unconscious and finally killed.

The operations were as follows:

1. Oblique wound at upper margin of cornea made with keratome (as in specimens 2, 3, 4, and 10).

2. The same made with Graefe knife (*a*) without iridectomy (as in specimen 7), (*b*) with iridectomy (as in specimens 6 and 8).

3. Simple punctured wound of cornea at margin (as in specimen 5).

4. Vertical wound of cornea through centre with Graefe knife (as in specimen 9).

5. Wound at lower margin of cornea with Graefe knife (as in specimens 11 and 12).*

In all cases the anterior chamber was completely evacuated, the cornea becoming wrinkled and the iris lying in contact with its posterior surface.

The method in which the operations were carried out was as follows: When the animal was fully under the anæsthetic (ether or chloroform) the conjunctival sac was thoroughly douched with a weak carbolic lotion, the eye (in the case of rabbits) was artificially proptosed, the operation performed, the eye allowed to recede to its normal position, and the lids closed. The animal was then either kept under the anæsthetic and finally killed, or in other cases was allowed to recover, and after a certain interval placed again under the anæsthetic and killed, and to avoid any struggling this was done by putting it under a bell jar with chloroform. The head was then cut off and placed in a jar containing a 10 per cent. solution of formalin. At the end of twenty-four hours the eye was carefully enucleated and again placed in formalin for several days; it was then cut through, one half mounted as a specimen and the other preserved for microscopical examination. By taking all this care the iris hardened and retained its original position when the eye was opened, so that the size of the anterior chamber remained exactly the same as at death.

I made altogether twenty experiments, and I have selected the eleven specimens which I show to-night as fairly representing the results. The experiments I divide into two classes: the *first* class those where the animal was kept under the anæsthetic all the time, and the *second* class those where it was allowed to recover.

* The size of the Graefe knife wound was the same as that produced by the keratome (except in the case of the punctured wound).

Class 1.—The specimens in this class are 2, 3, 4, and 10; the interval between the operation and death was short (under half an hour), and the animal was absolutely quiet the whole time. I found that when the anterior chamber was completely emptied of aqueous by the insertion of a keratome at the upper margin of the cornea, it began to refill almost at once. In specimen 2, where the rabbit was killed two minutes after the operation, there is a distinct anterior chamber; and in specimen 4, where twenty-five minutes elapsed before death, the size of the chamber appears normal, and, in fact, it is hard to see any difference between it and the unoperated-upon eye, which is shown in specimen 1, and which was the fellow eye. Experiment 10 (specimen 10) was most interesting and instructive. The wound of the cornea was made at its upper margin with a keratome passed in obliquely, the aqueous was all let out, the cornea becoming wrinkled, the iris lying in contact with its posterior surface. The animal being still kept under ether, the lids were carefully closed, and after the interval of one minute I separated the lids, taking care not to expose the wound, and discovered that the anterior chamber had already begun to be formed, the iris was not in contact with the cornea, and the cornea itself looked normal. I watched this gradual re-forming of the anterior chamber for fifteen minutes, by which time the eye appeared to be quite normal, the anterior chamber being the same size as before the operation; I then reopened the wound with a blunt, grooved spud, and again let out the aqueous, closed the lids, and in five minutes killed the rabbit. The result you see in specimen 10; the anterior chamber is almost fully re-formed in the short time of five minutes.

Class 2.—In this class the interval before death was longer and the animal was allowed to recover from the anæsthetic. The animal's movements interfered considerably with the rapid repair which we saw in Class 1; for instance, look at specimen 5. In this experiment a small punctured wound was made with a Graefe knife at

the upper corneal margin smaller than the keratome wound in specimen 4, and all the aqueous let out; the rabbit rapidly recovered, and was killed half an hour later. The anterior chamber is not fully re-formed, and this specimen compares unfavorably with specimen 4 (in the first class), although the interval before death in the latter was shorter. The same remarks apply to specimens 6, 7, 8, where the intervals before death were respectively 1 hour 55 min., 2 hours 5 min., and 2 hours 30 min. If we compare these specimens we see that the longer the interval before death the better formed is the anterior chamber. In specimen 8 it is fully re-formed. In some of the experiments I performed an iridectomy at the same time, but I could not find that this made any appreciable difference in the time taken for repair.

When the cornea was incised across the centre vertically, the wound gaped and repair was much slower (see specimen 9, where in 2½ hours the anterior chamber is not properly re-formed).

Wounds at the lower margin of the cornea (see specimens 11 and 12) did badly; the wound was inflamed and the aqueous was turbid. This was due to the irritation produced by the animal constantly rubbing the eye with its paw and the movements of the lids.

There are two points to be deduced from these experiments:

(1) The rapidity with which the anterior chamber re-forms, and

(2) The great influence for good that rest has on this repair.

1. *The rapidity with which the anterior chamber re-forms.*—Although one knows from constant experience that, under favorable conditions, the anterior chamber very soon begins to re-form after loss of the aqueous, still I was not prepared to find that the time was so short, and I think that this knowledge may help us in the treatment of some cases. Take, for instance, cases where the aqueous

is lost accidentally during an operation on the eye, when its presence is very necessary for the proper performance of this operation. For instance, the Graefe knife may be inadvertently introduced with the cutting edge the wrong way in a cataract extraction; most text-books tell us that when this happens the operation must be postponed till the next day, while all that is really necessary is to bandage the eye and keep the patient perfectly quiet for half an hour (at the outside), and then complete the operation, thus saving the patient a great amount of extra suspense and ourselves a considerable amount of annoyance. Again, in perforating wounds of the cornea which are seen some hours after the injury, it may be desirable to re-open the wound in order to disengage some small piece of iris, &c.; there should be no hesitation in doing this, as we delay the process of repair very little, if at all. If corneal wounds unite so readily, we ought to be able to inspect them much earlier after an operation than is generally done. Take, for instance, cataract extraction without iridectomy, when the incision is mostly in the cornea; how important an early inspection of these cases is, in order to ascertain if there has been any prolapse of the iris, and surely it can be safely done at the end of twenty-four hours if all the conditions are favorable.

2. The second point that these experiments teach us is, the immense importance of absolute rest, after all operations on the eye, during the first few hours. Contrast specimens 2, 3, 4, and 10, where rest was fully obtained, with the remaining ones. Compare specimen 4 with 5, and look at specimens 11 and 12, where the condition of unrest was at its worst.

Although I made many microscopical sections, I found nothing new in the pathology of the process of repair in the corneal wounds. Oblique incisions at the upper margin showed the least scar, the lips of the wound were glued together with fibrin, and small round cells were present in very small amount.

Wounds made vertically through the centre of the cornea, and also those made at the lower margin, gaped considerably and made large scars.

(*October* 21*st*, 1897.)

Mr. Devereux Marshall said he would be interested to know whether Mr. Clarke had made any experiments, with regard to conjunctival flaps, to ascertain the rapidity with which the anterior chamber became re-formed afterwards.

Dr. Batten said Mr. Clarke spoke, in his paper, of repair, but he (Dr. Batten) would question whether it actually was repair. As to operating on rabbits, he thought he was correct in saying that the cornea in the rabbit was thicker than in the human subject, and if the wounds were at all oblique he thought they closed up more rapidly. The greater thickness of the cornea and the obliquity of the wound afforded the anterior chamber a better chance of being sealed up without there being any repair, the under flap acting as a valve.

The President said he was not sure what Mr. Clarke meant by "union;" whether the word indicated a complete and perfect form of union, or merely meant the first sealing of the wound. A slight sealing of the wound was enough to cause the aqueous humour to be retained. But what was of interest for the surgeon to know was the earliest moment when complete and absolute union was formed, for that was the earliest period after which they might conclude there would be no infection. He would suggest that Mr. Clarke might make his investigation much more complete and more valuable if he would go a little further and would ascertain up to what moment after the wound in the cornea was made infection might take place. The paper was an extremely interesting one.

Dr. Argyll Robertson said he would like to refer to one little omission in the paper, one of very considerable importance, viz. the size of the corneal wounds made in

the experiments. He thought all present would bear him out in saying that the rapidity of union depended very considerably upon the extent of the incision.

Mr. Ernest Clarke, in reply to Dr. Argyll Robertson, said he had in his paper, but omitted to read it, a statement that the size of the corneal wound was that made by passing an ordinary medium-sized keratome up to the hilt, viz. about 6 mm., and he took care that in all the wounds the Graefe knife and keratome should be the same size, with the exception of the punctured wound in specimen 9.

In reply to the President, Mr. Ernest Clarke said he intended and hoped to have introduced some infective material into the conjunctival sac, and thus prove the point raised, and whether real repair had taken place, but the Vivisection Act did not allow it; he had to operate under strict antiseptic precautions. He used the word "union" advisedly, he did not intend to convey by it an impression of actual healing.

In reply to Dr. Batten, Mr. Ernest Clarke pointed out that in specimen 10 he reopened the wound after it had been closed fifteen minutes, and he had to exert a considerable amount of pressure with the spud to separate the edges of the wound, showing that those edges were not in simple mechanical apposition.

In reference to Mr. Devereux Marshall's observation, Mr. Ernest Clarke said he particularly avoided making a conjunctival flap, because his experiments were on the union of the cornea only, and he did not wish to introduce any other elements.

2. *Some matters of interest in cataract extraction.*

By Surgeon Captain H. Herbert, F.R.C.S., I.M.S.

1. *The use of strong lotions.*—In India our eye-work is done under somewhat unfavorable conditions. The surgeon has to hurry through a very large amount of work; the condition of the conjunctiva is not always very good; the patients, assistants, and surroundings are more or less unclean; and the supply of dressings and appliances is often scanty. The fight against infection of wounds is a severe one, and the average results will not compare with those obtained in this country. The cataract extractions performed in the Cowasgee Jehangier Hospital, Bombay, in 1893, gave 3·4 per cent. of suppuration, and 7·2 per cent. of iritis; in 1894 there was 6·3 per cent. suppuration, and 2·5 per cent. iritis. During portions of 1895 and 1896 I extracted 270 lenses there, using 1 in 5000 perchloride as an antiseptic. Exercising the greatest care, I was unable to entirely exclude infection; I got 1·1 per cent. suppuration, and nearly 3 per cent. severe plastic iritis. But in May, 1896, following Surgeon Major Bamber, of Rawal Pindi, I adopted strong perchloride (about 1 in 2300) as a routine antiseptic. Since then I have performed 281 extractions (of which four were linear extractions), besides a considerable number of smaller operations, iridectomies, &c., and the entire series has been free from all evidence of definite infection introduced at the time of operation. There has been no suppuration of wounds, and no iritis severe enough to seriously affect vision. In one of my most recent cases, infection entered the eye (about ten days) after the operation; an acute vesicular dermatitis developed, which discharged freely into the conjunctival sac; a small hypopyon formed, but the pupil dilated readily, and other symptoms were slight. When I left Bombay a few days later, the pus was still there, but the dermatitis was cured, and the prognosis not altogether bad. In

another case a large prolapse of iris occurred. At the time of removal of the prolapse the pupil was found fully occupied by a thin layer of exudation; this, however, became absorbed almost completely under treatment, and vision afterwards was $\frac{6}{60}$, with astigmatism uncorrected. My good results must be attributed mainly to the strong lotion employed, for in other respects the operations have been done almost exactly as before. A little iodoform is now dusted on the wounds, and a little more care is taken with the hands of the assistants; but as I have always seen to the cleaning of instruments myself, the assistants have very little to do with the operations.

The disadvantage of the strong antiseptic, which has prevented its more general adoption, is, of course, the irritation produced by it. In over seventy cases I used the lotion freely before the cocaine instillation, again after it, and a third time about the end of the operation. This was far in excess of actual requirements, and resulted very frequently in an inflammatory reaction which was not wholly limited to the surface. The hyperæmia extended in some degree to the iris, adding considerably to the reaction resulting from traumatism, and leading to much greater frequency of posterior synechiæ, and consequent increase of after-cataract. The reaction to the irritant lotion varied very much. Smooth, thin, transparent conjunctivæ resented it greatly, while those bearing the marks of former repeated inflammations were found to tolerate much more of it. I now use the lotion freely to face, lids, and conjunctiva before the cocaine period, and at the end of ten minutes usually find on the conjunctiva an accumulation of mucus filled with epithelial cells, which is removed by gently rubbing the lids together.* On thick, opaque, and scarred conjunctivæ this formation of mucus may not be found. In these cases I again use the antiseptic before operating, but in no case is it applied to the eye after the operation is begun. By this selection

* A second removal of mucus with a curette is generally needed at the end of the operation.

of cases and moderate use of the lotion excessive reaction is avoided, and the results are almost, if not quite, as pretty as in the successful cases of the days of weaker lotion, while the exclusion of infection appears to have been sufficiently complete. But even now, to guard against possible irritation of the iris, atropine is generally dropped in the eye twenty-four hours after the operation, and if at the following dressing the pupil is not found moderately dilated, orders are given for the frequent use of atropine until the pupil gives way.

What I have to say is briefly this :—In India the only long series of good results hitherto obtained are apparently those of Bamber and myself, under the use of strong perchloride. Our Indian experience shows how much easier it is under unfavorable conditions to make certain of preventing infection by a strong antiseptic than by a mild one, and the series of cases is sufficient to show exactly the damage to be expected from an excessive use of the more irritating application. Many surgeons in this country seem still content to get a small proportion of losses from infection, and appeal to "auto-infection" for an excuse, whereas judging from the long-continued success of a few operators, *e. g.* Trosseau, of Paris, the one thing which a patient has a right to demand nowadays is freedom from risk of infective processes, for its attainment requires no special skill, but merely the adoption of a correct method and the exercise of care and trouble. I feel strongly that surgeons who get occasional suppurations and infective iritis would consult the best interests of their patients by banishing these complications at the cost of a few synechiæ and of a few shreds of capsular opacity. What has struck me forcibly concerning this "after-cataract" is the very small effect it has on the acuteness of vision, contrasting with the later development of opacity which appears to be often associated with wrinkling of the membrane. The patients with this early after-cataract presented no striking difference as regards vision from the few cases in whom I obtained a perfectly

clear pupil by extraction of the lens in its capsule. And the irritation produced by the strong lotion may in moderation be not a bad thing. The solution acts not only as a germicide, but to a slight degree also as a caustic application. The older superficial epithelium, possibly microbe-containing, is cast off, and leucocytes attracted to the surface are ready to dispose of organisms in the conjunctival sac.

Drying of the cornea.—While the cocaine is being used the eyelids are kept closed, and during my operations the surface of the eyeball is kept moist by the constant dropping of boiled saline solution. In some operations performed in this country I have seen the corneal surface distinctly dry at times, and I cannot help thinking that this desiccation must account for some of the unexplained suppurations. In this connection a report * by Dr. Max Walthard is interesting. His experiments showed that in abdominal operations an exposed peritoneum, if allowed to become dry, is susceptible of infection by organisms which a similarly exposed peritoneum, kept moist, will cope with successfully. In the same way one must expect the normally moist corneal epithelium to be so damaged by drying as to lay it open to the attacks of pyogenic organisms. The use of saline solution is of advantage also in that the fluid is available for irrigation of the anterior chamber whenever blood, cortex, or uveal pigment needs removal.

Acute dermatitis.—I have already alluded to a case of acute inflammation of doubtful origin, which began in the lids of the eye operated upon and spread over a large portion of the head and face, the affected skin becoming covered with large clear vesicles. There was no general systemic disturbance. No atropine had been used when the inflammation began, and its continued subsequent use did not interfere with the healing of the skin. Irritation from the perchloride at the operation and the subsequent confinement under a bandage (dry boracic gauze and

* 'Brit. Med. Journ.,' 1892, vol. ii, 454.

absorbent wool being the only dressings) may have set up the process in a very delicate skin, and the discharge from the vesicles may account for its continued spread. The vision in this case was $\frac{6}{40}$ and Sn. 2, seven weeks after operation.

In another man the same sharply defined erysipelatous-looking inflammation appeared, but no vesicles formed and the affection did not spread far beyond the lids.

(*November* 11*th*, 1897.)

The Chairman (Dr. Berry) said they were much indebted to Dr. Herbert for his interesting remarks upon a subject which must be of great interest to all of them. From the point of view of asepsis, the conditions in the eye were very different from those in other parts of the body, and therefore they naturally had to act differently in practice. Of course every operator strove to procure asepsis as opposed to antisepsis; still, it was interesting to find that a thoroughly antiseptic measure such as Dr. Herbert adopted had resulted in such a long series of successes, whether altogether on account of that measure or accidentally he did not know. They could understand that the region surrounding the eye, the conjunctival sac, must be the seat of inflammation-producing organisms, and he did not know what the result of strong antiseptics might be. Sometimes antiseptics had been blamed for certain inflammatory conditions which had come on afterwards, leading the operator to avoid antiseptics and use asepsis as far as possible. Still it was possible that after the experience of Dr. Herbert it might be right to adopt an antiseptic measure of the kind he described. He was opposed to making experiments. It would be interesting to hear whether members of the Society had the same experience, whether they had gone in thoroughly for strong antiseptics (stronger than 1 in 5000 corrosive sublimate or 1 in 40 carbolic) as opposed to asepsis. The subject had recently been discussed by the British

Medical Association in Canada, therefore possibly Mr. Nettleship would contribute to the discussion.

Mr. NETTLESHIP said he had little to say on the matter, but the meeting of the British Medical Association in Canada was distinctly in favour of asepsis, not antiseptics. It occurred to him as possible that a strong solution of the perchloride might be well borne by the natives of Bombay, though it might cause too much pain to be tolerated here ; at any rate it was worth consideration, from the point of view of the amount of pain which could be borne. He believed the native Indians were said to be very tolerant of pain as a rule. Still such a view should not be an obstacle to the careful consideration of the points put forward by Surgeon Captain Herbert.

Dr. HILL GRIFFITH said he had never used anything stronger than 1 in 5000 corrosive sublimate, and he had seen some bad results from that, chiefly in the direction of opacity of the cornea, and he believed it was due to the subsequent washing out of the eye *after* the corneal section was made. If Dr. Herbert had used 1 in 2500, he would be glad to know whether he, Dr. Herbert, had had any cases of opacity of the cornea. Even with a strength of 1 in 5000 there was a sufficient number of bad results. In one case a very dense opacity in the cornea was produced, reducing the vision to 16.

Mr. CARGILL pointed out that 1 in 2000 was not a germicide. When he was house surgeon at King's College Hospital, Lord Lister was about to operate on a scirrhus of the breast. Through an oversight a nurse came in from another ward where there was a case of erysipelas, and attended to the sponges. At that time the sponges were washed in a 1 in 2000 corrosive sublimate. In spite of that the wound developed erysipelas. An inquiry was made as to how it was caused, experiments were made by Professor Crookshank, who found that 1 in 2000 corrosive sublimate merely inhibited or paralysed the microbes for a time, and that when it was neutralised they returned to life. That being the

case, it seemed to him to be a mistake to irritate the conjunctiva with a 1 in 2000 corrosive sublimate as a routine, and run the risk of striped keratitis developing.

3. *The aseptic treatment of wounds in ophthalmic surgery.*

By Angus McGillivray, M.D.

It is impossible to shut our eyes to the fact that the treatment of wounds has undergone a very rapid process of evolution since the introduction of antiseptic principles into surgery by Lister. This is not to be wondered at when we consider the intimate relation that exists between the rapidly advancing science of bacteriology and modern surgical technique. By the application of antiseptics in the treatment of wounds, Lister proved beyond all doubt that the secret of success in operative surgery lies principally in the exclusion of micro-organisms from wounds, both during and after operation. With the advent of such an important discovery, it is not to be wondered at that surgeons were carried away with the idea that the destruction of the invading micro-organisms must be carried out at all costs, the protection of the cut tissue of the wound against the chemical agents employed being lost sight of, or at all events thought to be of secondary importance. We must, however, remember that the science of bacteriology was practically in its infancy at the commencement of the antiseptic era, for Lister's discovery, besides being of incalculable value to surgery, gave a great impetus to the study of bacteriology, which study has culminated in the production of acquired immunity against some of our most virulent maladies.

As the life history of micro-organisms became better understood, antisepticians found that certain precautions, which they had adopted at the outset, were not only un-

necessary, but were even harmful, and this resulted in certain important modifications in the original methods. These modifications consisted chiefly in reducing, by a very appreciable extent, the strength of the antiseptics employed, especially those that came in contact with the wound, and the abandonment of the carbolic spray. The dangers of aërial infection, which haunted the surgeon like a nightmare, were removed by the simple discovery that micro-organisms, like dust particles, were subject to the law of gravitation. This led to the adoption of special precautions, which have been successful in removing this formidable difficulty, or at least making it no longer a practical objection. Next came the disinfection of instruments, mops, dressings, and ligatures by heat sterilisation, as immersion in chemical "antiseptics" could not be relied upon. Thus the use of chemical disinfectants became restricted, in the practice of most surgeons, to the disinfection of the surgeon's hands, and the skin over the part to be operated on.

The important researches of Lister, Tyndall, Pasteur, and others, proving that unexposed healthy tissues are free from micro-organisms, and that suppuration is due to the introduction of micro-organisms from without, paved the way for still further modifying, or simplifying, antiseptic methods. It was not, however, until the importance of the natural antiseptic property, or natural immunity of living tissues came to be more appreciated, that some surgeons discarded chemical antiseptics in operations altogether, and preferred normal saline solution, as that produced no irritation of the wounded tissues, tending rather to keep them as nearly as possible in their physiological condition.

It is well known that antiseptic solutions, however weak, irritate or benumb the cut tissues of a wound, and that this irritation is, as a rule, in proportion to the strength of the solution employed. In some cases the antiseptic actually destroys the tissues on the surface of the wound altogether, so that, before union takes place,

the dead part thus lying between the lips of the wound must be got rid of. Now if the tissues are irritated or benumbed by chemical antiseptics, they are less able to ward off any micro-organisms that may have found their way into, and are left in the wound. In other words, the natural immunity or antiseptic property of the tissues becomes impaired or destroyed.

Again, it has been shown experimentally that the removal of micro-organisms from wounds by douching with antiseptic solutions depends chiefly, or probably entirely, on the mechanical irrigation, and not, as was formerly supposed, on the germicidal action of the antiseptic. The antiseptic solutions employed in surgery for douching purposes have no practical germicidal properties unless they are brought into direct contact with the organisms for several hours, or even days. This, however, would be a very undesirable procedure, even if possible, as prolonged action of the antiseptic is disastrous to the tissues. The resisting power of the organisms against antiseptics is considerably greater than that of the living tissues, so that any attempt to destroy organisms in a wound by chemical antiseptics will play havoc with the tissues long before the organisms become affected. The addition, therefore, of an antiseptic to a solution for douching purposes is not only superfluous, but actually injurious to the tissues.

The result of these discoveries has been a considerable modification in the practice of antisepticians, a modification which is also a simplification, and which, carried further, has led to the adoption of asepsis as a natural development.

In practice, most surgeons, antisepticians and aseptic ians alike, sterilise their instruments by heat, they employ methods similar in principle for the disinfection of their hands and the skin of the patients, and take the same or similar precautions in preparing their operating theatres and the patients' surroundings. They differ, however, in the following :—The antiseptician employs

antiseptic solutions for his wounds, for immersing his instruments in after sterilisation, and uses, as dressings, absorbent materials impregnated with chemical antiseptics. The aseptician, on the other hand, carefully removes the chemical disinfectants both from his own hands and from the skin over the part to be operated on, the instruments are not kept in antiseptic solutions after sterilisation, the wound is douched only with sterilised saline solution, antiseptics are studiously prevented from coming in contact with the wound, and the dressings are composed of sterilised absorbent materials. His object in such precautions is to disturb the tissues of the wound as little as possible, and he trusts to the natural antiseptic or germicidal action of the tissues in combating or destroying any micro-organisms that may have been left in the wound, rather than trust to artificial means, which impair the natural immunity of the tissues. The aseptician adopts the same or analogous precautions during his operations, as regards the exclusion of micro-organisms and antiseptics, as a bacteriologist adopts in the preparation and subsequent inoculation of his culture media,—that is, he brings the rules and methods employed in the bacteriological laboratory into the operating theatre with him. In short, aseptic surgery may be defined as *applied bacteriological methods in surgical technique.*

Having thus stated the position of the aseptician generally, let me illustrate more fully by describing and analysing a typical operation, such as cataract extraction, performed on aseptic principles.

Cataract extraction.—On admission into hospital the patient gets a warm bath and a change of underclothing, and is then put to bed. The face is carefully washed with warm water and soap, particular attention being paid to the folds in the skin of the eyelids. In the evening the eyes are bathed with sterilised salt solution ·6 per cent., and a *test dressing* is applied over the eye to be operated on. Should this dressing be found unstained when removed next morning the eye is considered suitable for

operation. We, however, prefer the patient to be in hospital for at least a couple of days before being operated on, so that he may become accustomed to his new surroundings. On the morning of the operation, and about an hour and a half before the surgeon's arrival, the eyelashes are cut short, and the face and eye are treated as on the day of admission. Sterilised cocaine drops 5 per cent. are instilled into the eye for twenty minutes before operating to ensure complete anæsthesia of the deeper parts, corneal desiccation being prevented by keeping the eyelids closed. The surgeon wears a white operating jacket, closely fitting at the neck, with sleeves rolled halfway up the forearm. His hands are very carefully washed in water, and disinfected with a carbol-sublimate solution, which is removed before operating by washing the hands in sterilised water. The margins of the eyelids, especially the openings of the Meibomian ducts, are gently rubbed with a sterilised mop and saline solution. This mechanical cleansing can be carried out without irritating the eye if the margins of the eyelids, after being approximated, be pressed together until they become slightly everted. After this the patient is directed to keep opening and closing his eyelids while a stream of saline solution at the temperature of about 90° F. is made to play over the eyeball. The upper lid is then everted, and the conjunctival surface of the tarsus carefully cleansed by pouring the solution from a little height. The cleansing of this part of the conjunctiva is very important, seeing that the tarsus is to lie in actual contact with the wound, and in reality form the innermost and therefore the most important part of the dressing. The lower cul-de-sac is in turn exposed and douched, and the lachrymal sac emptied by making firm pressure over it with the finger. Flushing the lachrymal sac and tear duct on the evening before operation was practised by us for some time, but was abandoned about eighteen months ago, because it produced more or less redness and irritation of the conjunctiva at the inner canthus. The upper cul-de-sac receives attention next.

Special douches have been devised for the purpose of irrigating the upper cul-de-sac, but they are all open to the objection that the nozzle is apt to irritate the conjunctiva if employed with any degree of thoroughness. We now content ourselves with the following simple means of dealing with the upper cul-de-sac :—Place the patient's chin on a level slightly higher than the forehead, and lift the upper eyelid forward off the eyeball ; the saline solution from the douche is thus allowed to pass down into the cul-de-sac and cleanse the part freely without causing irritation or discomfort. [It may be of interest to mention in passing, that normal saline solution when dropped into the eye has a soothing effect, whereas ordinary tap water temporarily irritates the eye to some extent.]

The instruments are sterilised by being kept submerged in boiling water for two and a half minutes. They are then laid out in the order in which they are to be used on a sterilised cloth, and covered up till required.

Operation.—The speculum is now inserted, and the fixation forceps applied just below the cornea. The eyeball is rotated downwards, and the exposed upper corneo-scleral region corresponding to the wound douched with a stream of saline solution. A corneo-scleral incision, with 3 mm. flap and a narrow conjunctival flap, is made with a sharp Graefe's knife. After completing the section the fixation forceps is removed, but the patient is enjoined not to rotate the eye upwards until the operation is completed. This avoids the possibility of the wound being contaminated by the margin of the upper eyelid. A narrow iridectomy and a free capsulotomy are performed, and the lens is expelled by spoon and curette, without any difficulty as a rule. After removing any soft lens matter, and replacing the pillars of the iris coloboma, the lips of the wound are freed of any débris by a gentle stream of saline solution. The conjunctival flap is carefully replaced on the sclerotic, and the speculum removed. In removing the speculum care should be taken that the upper lid is carefully lifted over the

wound, and not allowed to glide over it, for fear of contaminating or displacing the lips of the wound.

Dressing.—Over the eye is laid an oval piece of moist lint or gauze $1\frac{1}{2} \times 1$ inches, which has simply been sterilised, then two layers of absorbent cotton wool, just large enough to overlap the lint. This dressing is retained in position by a vertical and horizontal strip of half-inch adhesive rubber plaster. It is called a *single plaster dressing.*

The patient is then wheeled on the operating table into the ward, and placed carefully in bed. A large double shade of brown paper is worn over both eyes from the time of the operation till leaving the hospital.

At the first dressing, forty-eight hours after operation, the lint next the eye is, as a rule, unstained; there is seldom any trace of gumminess of the lids, even in very old and decrepit people, and only a trace of conjunctival injection over the globe. During this and subsequent daily dressings the eye is bathed with saline solution, and sterilised atropine drops are instilled to dilate the pupil and keep the iris at rest. The patient is allowed to sit up in bed with back support on the third day, or sooner if the supine position be contra-indicated. He is allowed to move about in the ward, and have his dressings permanently laid aside on the seventh day. He leaves hospital three weeks after operation with protective goggles, and receives his cataract glasses three weeks later, unless needling for secondary cataract be found necessary.

This, then, is a general outline of the application of aseptic methods as illustrated by the operation for senile cataract. It will be observed that no chemical antiseptic came in contact with eye either before, during, or after the operation, and everything that touched the eye was aseptic. Let us now examine the methods employed more closely, and for convenience take them in the order in which they occur in the description of the operation just given.

The test dressing.—A test dressing has been regularly

employed by me in the ophthalmic department of the Dundee Royal Infirmary for nearly three years, to ascertain before operating how the conjunctiva will behave under a dressing. The condition of the conjunctiva is very often deceptive, particularly in old people. It may present a normal appearance on examination, but when covered up for some hours it not unfrequently begins to discharge, like a case of chronic conjunctivitis. The presence of conjunctival discharge contra-indicates operative interference on the eyeball, because discharge is associated, as a rule, with micro-organismal activity. Now if in some cases we have no means of ascertaining the actual condition of the conjunctiva till the first dressing after operation, the importance of a preliminary or test dressing becomes evident. An unhealthy condition of the conjunctiva, for example, may not only be detected, but treated before operating, and thus save both time and trouble afterwards. With the object of ascertaining approximately the relation between this conjunctival discharge and the number of micro-organisms in the conjunctiva, I examined bacteriologically a number of eyes that had been prepared for operation. The experiments consisted in inoculating broth tubes, chiefly from the upper cul-de-sac, and keeping them at body temperature. The results obtained are briefly as follows. In the cases where we found no discharge, or simply a trace on the dressing, the broth nearly always remained clear throughout the period of experimentation, namely, fourteen days, whereas in the cases where the discharge was well marked the broth became very turbid in a couple of days or thereabout.

Preparation of drops, lotions, cotton wool, mops, and surgeon's lint.

Drops are prepared with distilled water and boiled for at least five minutes in a Strochein's drop bottle, or preferably in a glass bulb and nozzle in one piece.

Physiological salt solution (·6 per cent.) is prepared with pure sodium chloride and distilled water, and boiled for five minutes in a special douche, which prevents contamination of the solution after being sterilised. The douche is simply a Florence flask wash-bottle, with the nozzle and air-tube modified. The nozzle, when not in use, is capped with a larger piece of glass tubing sealed at one end, and the outer end of the air-tube is bent at a sharp angle so as to look downwards. Organisms are thus prevented from entering while the douche is standing, so that the solution can be kept sterile for any length of time. If the douche be used, there is a possibility of organisms entering through the air-tube with the ingoing air. This, however, can be overcome, if desired, by placing a small plug of cotton wool in the outer end of the air-tube.

Cotton wool is cut to the size and shape required for the dressing, and placed in small tin boxes provided with well-fitting lids. It is then subjected to nascent steam in a Schimmelbusch steriliser for one hour, which gives ample time for securing complete sterilisation through and through. The boxes are open during sterilisation, but are immediately closed after the process is completed. They can be carried about without the slightest fear of contamination, and are extremely convenient for private work, one box being sufficient to hold all the dressings required during the treatment of the case.

Mops and lint are made of absorbent cotton wool and surgeon's lint respectively. They are sterilised by being kept submerged in boiling water for half an hour, then wrung out with disinfected hands and placed under cover till required in a sterilised dish with overlapping lid. The lid of the mop dish is only removed while the surgeon or his assistant picks up a mop or piece of lint, and then it is lifted straight up for obvious reasons. The risk of aërial infection is thus obviated, as may be seen from the following experiments. Broth tubes were inoculated with pieces of mop and lint from the upper

layer left in the dish after the operation for cataract. Eight experiments were made at different times, with the result that the tubes remained clear throughout the fourteen days. This is very satisfactory, seeing that the experiments were made after operations performed in the wards. In order to save repetition I may mention at this stage that, accompanying the bacteriological experiments connected with this paper, a sufficient number of check or control experiments were performed, which gave negative results.

Disinfection of the surgeon's hands.—It is true that disinfection of the hands is not so important in ophthalmic operations as in operations on other parts of the body, because the ophthalmic surgeon, in a good number of his operations, does not require to touch the wound with his fingers. Still it is well to be prepared in case of accident or necessity. The method of disinfection we employ is as follows. The hands are carefully washed in warm water, with soap and soda and the free use of a clean nail-brush. They are then placed under a running tap of tepid water to remove the alkalies, and this is followed by immersion and scrubbing in a disinfecting solution, consisting of sublimate 1 in 1000 and carbolic 1 in 80, for three minutes. The hands are allowed to dry by evaporation, in order that, as the disinfecting solution adhering to the skin becomes concentrated, its germicidal properties are increased. We tested the efficacy of this method of disinfection by inoculating a test-tube containing broth with scrapings taken from underneath the ten nails, the sublimate being carefully removed beforehand. Twelve experiments were made on different days, with the result that half the tubes remained clear. Six experiments were subsequently made with the disinfecting solution increased to double strength, then all the tubes remained clear. For practical purposes the weaker solution may be relied upon for disinfecting the hands, provided one has been

careful not to touch septic cases shortly beforehand. The sister's hands were always found aseptic after disinfection with the weaker solution, probably because she is not allowed to dress or even touch septic cases. The house surgeon's hands were invariably found to be septic after using the weaker solution, he having to assist at post-mortem examinations and in the accident room.

The operating room or theatre.—Every surgeon should have an operating room or theatre for his own use exclusively, as the principle of co-operative theatres is very objectionable when viewed from the modern surgical standpoint. It is well known that surgeons differ as regards surgical methods and operative technique. One may adhere rigidly either to antiseptic or aseptic principles, another may be indifferent. An aseptician would not allow septic cases into his operating theatre, yet he must virtually surrender his principles when the theatre is shared with others who hold different views. In the new ophthalmic department of the Dundee Royal Infirmary there is an operating theatre adjoining the wards, for my own use exclusively. Formerly I operated on cataract and such cases in the wards with the patient in bed, in preference to our new general operating theatre, notwithstanding that it is one of the finest in the kingdom. In properly ventilated wards, entirely under the surgeon's own management, where no septic cases are admitted, and where the patients are kept in bed, so that there is little moving about or stirring up of dust, the risk of aërial infection of wounds is, I venture to think, less than in some of our modern operating theatres, where all sorts of cases are operated on indiscriminately.

Preparation of operating theatre.—Our operating hour being 9.30 a.m., the theatre is prepared the night before to allow sufficient time for dust to subside. Everything must be scrupulously clean. To prevent draughts, which might stir up dust, the doors and windows are kept closed during operation and for an hour before. It

may, indeed, be taken as a surgical maxim that where there is no dust there are no micro-organisms, or, if any, they are few and far between.

Preparation of instruments.—To share an operating theatre with another is bad, but to have to use the same instruments is worse. The ophthalmic surgeon should have the exclusive use of his instruments ; not only so, he should possess two separate sets, one for aseptic, the other for septic cases. This is necessary on account of the delicate edge and build of most ophthalmic instruments. In practice, to be absolutely sure, a surgeon must regard all instruments of which he knows not the immediate previous history in the same light as instruments which have been used in septic cases. Such instruments require for their sterilisation immersion in boiling water for about ten minutes' time. But this is almost certain to ruin the edge and point, *e. g.*, of a Graefe's knife, thus rendering it useless for corneal section. Instruments used exclusively for cases such as cataract extraction require only a short immersion in boiling water for their sterilisation, especially when properly treated after use. Now if the surgeon has the exclusive use of his instruments, and possesses two sets, he can choose his set according to the case to be operated on, and give instructions for sterilisation as necessary, so that he is not compelled to sterilise the instruments longer than required. Repeated sharpening of an eye instrument affects the life of the instrument, so the system of each surgeon having his own set exclusively is more economical in the long run.

Having two sets for my own use in hospital, I can rely with confidence on procuring sterilisation without affecting the edge by the following method, which has stood bacteriological tests. New instruments, and instruments that have been used in what appear to be aseptic cases, are boiled for two and a half minutes in a one per cent. soda solution, dried with a sterilised piece of cloth, and stored in aseptic boxes in a glass cabinet. Before operating

the instruments to be used are placed for two and a half minutes in boiling water, and then laid out under cover on a sterilised cloth on a tray. The method is really a modification of Tyndall's "intermittent sterilisation."

From a germicidal point of view this intermittent sterilisation is superior to continuous sterilisation for a similar period, and also less injurious to the edge of instruments than the old method of placing them for the requisite time in chemical solutions worthy of the name disinfectant. Instruments used in septic cases are sterilised for five minutes before and after use in boiling water and soda solution respectively, and kept separate from the others on the bottom shelf of the cabinet.

Sterilisation of instruments by "dry heat" or "steam" is inferior to sterilisation by boiling. It requires much longer time, is more apt to rust the instruments, and requires a special and clumsy form of apparatus, whereas sterilisation by boiling may be efficiently carried out in a saucepan, or in any flat-bottomed domestic utensil. Dry heat affects the temper of the steel if used several times at 150° C. Sterilisation of cutting instruments by absolute alcohol is not reliable, because absolute alcohol is not a true germicide as is commonly believed.

The dressings.—An ideal dressing should be *aseptic, absorbent, and antiseptic*, the term aseptic implying the absence of micro-organismal vitality, and antiseptic that which prevents the functional activity of micro-organisms. The single plaster dressing which we employ consists, as I have already said, of a small oval piece of lint or gauze, which is sterilised by boiling, and two layers of sterilised absorbent cotton wool. The lint and cotton wool are both aseptic and absorbent, and, as the moist dressing becomes very quickly dry when applied, the dressing is essentially a dry one. Now as long as dressings remain dry they are antiseptic, because there can be no micro-organismal growth or activity without moisture. Dry dressings have been proved by experiment to do more

in preventing bacterial growth than any of the so-called antiseptic dressings hitherto recommended.

The secretion from wounds forms a very fertile medium for the growth of micro-organisms, and it is therefore necessary not only to remove such secretions from the wound, but to destroy or diminish their fertility as quickly as possible. This can be secured most effectively by employing absorbent dressings, and applying them so that evaporation is not prevented but encouraged. Our dressings, being light, afford every facility for the evaporation of any moisture that may escape through the palpebral aperture, and are sufficiently thick to be impermeable to micro-organisms from without. When correctly applied they rarely become displaced for several days even in the case of restless patients.

With regard to sterilised dressings, it must be said that they possess several advantages over dressings impregnated with chemical antiseptics. For example, the wool can be cut to the exact size and shape before being placed in the steriliser, whereas the preparation and storage of antiseptic wool, &c., both in the factory and in the operating theatre, is almost certain to make them septic. Dressings may be antiseptic while not aseptic, the terms antiseptic and aseptic not being synonymous.

My object in applying the lint moist is that when the lint dries it forms a mould of the eyelids, which assists materially in preventing the dressings being displaced. Further, if necessary, the lint and mops can be sterilised along with the instruments in boiling water, and if the lint be used double or threefold and firmly wrung out, it is not essential that the cotton wool used in the dressing be sterilised. In this way one can save not only time, but also the expense and inconvenience of a steam or dry heat steriliser.

The use of a single dressing after operations on the eyeball is preferable to the old double dressing. The freedom of having one eye uncovered, even should that eye be almost blind, appears to have a psychological

effect on patients, which I believe to be of importance in the healing of wounds. Again, when both eyes are covered up, the secretion of tears, being a reflex act, is practically in abeyance. But when one eye is left open the secretion of tears goes on in both eyes, and we thus avail ourselves of a very important and natural process of irrigation. It may be said that the movements of the sound eye, by producing concomitant movements of the other eye, disturb the healing process of the wound, yet after three years of the exclusive use of the single dressing my wounds heal certainly as rapidly and soundly as before, and I have never yet seen even the slightest suggestion of the formation of a cystoid cicatrix.

The use of plaster instead of bandages which pass round the patient's head is a decided improvement, because it rarely becomes displaced, whereas bandages are apt to become displaced by the movements of the head, especially if the patient has a restless night, and the lips of the wound may in consequence be disturbed.

Ophthalmic wards.—The wards in which the patients sleep after operation should be thoroughly but carefully ventilated. Draughts should be avoided. I keep my wards quite bright, any degree of light, short of direct sunlight, being permitted. If the face and eyes be shaded with a large double shade there is no necessity for placing the whole ward in darkness. We are apt to forget that light posseses very important germicidal properties. Even diffuse daylight plays a most important part in the destruction of bacteria, and therefore from a purely sanitary point of view our wards should be kept as well lighted as the nature of the cases occupying them will permit. The large double shade, besides keeping the face and eyes in darkness, serves another very important function, namely, in preventing organisms falling on the face and eyes.

Preparation of the face and eye for operation.—It is now generally agreed that the conjunctiva, even in its normal condition, contains several species of micro-organisms,

including many of the pyogenic group. This is scarcely to be wondered at when we remember that we have in direct proximity to the eye a micro-organismal cesspool—the lacrymal sac. There are many difficulties to contend with in rendering the field of operation aseptic, not only so, but in keeping it aseptic during the healing of the wound. Can these difficulties be surmounted? With a determination to be able to answer in the affirmative, I made a series of bacteriological experiments after applying the following treatment. The eye was carefully bathed with sublimate solution 1 in 10,000 thrice daily for a period not less than three days, and the face and eyelids were treated as already described. Before making the inoculations the conjunctival cul-de-sac was carefully flushed with sublimate solution 1 in 5000, the tear ducts having been syringed with the same solution on the previous evening. The eyelids were then everted and their conjunctival surfaces brushed with a mop and lotion, followed by a second flushing of the cul-de-sacs. After the lapse of a couple of minutes or so the parts were again carefully flushed with sterilised water to remove the sublimate. A small sterilised platinum loop was then passed from end to end of the upper cul-de-sac five times without touching the margin of the eyelid, and finally brought out over the caruncle. A loopful of conjunctival secretion thus obtained was placed in a broth tube, and kept at body temperature for fourteen days. Twenty such inoculations were made from cases prepared for cataract extraction or iridectomy. The results, I regret, did not come up to my expectations, for only half of the tubes remained clear. A second series of inoculations was made at the first dressing, forty-eight hours after operation, from the cases where the broth tubes kept perfectly clear up to that time, *i. e.* from the cases which appeared aseptic. The results were contrary to my expectations, for all the tubes became very rapidly turbid.

The first series of experiments shows that one cannot always rely on making the conjunctiva aseptic, even with

sublimate solution, aided to some extent by mechanical cleansing. Sublimate 1 in 5000 is probably the strongest and most efficient antiseptic that the eye can tolerate without producing some considerable irritation. Weeks has shown that sublimate 1 in 4000 to 1 in 5000 destroys pyogenic staphylococci and streptococci in from two and a half to three minutes; yet it must not be forgotten that the time required to destroy micro-organisms in a mucous membrane, such as the conjunctiva, must be considerably greater than that required in a test-tube. The second series of experiments shows either that, while the conjunctiva can in some cases be made aseptic, it does not remain so for any appreciable length of time, or, which is more probable, that the asepticity of the conjunctiva produced by antiseptic solutions is limited to the surface, the deeper layers still containing micro-organisms which cannot be got at, but which afterwards come to the surface. This would prove that antiseptic irrigation, after all, is purely mechanical, not germicidal, in thus removing surface micro-organisms. But antiseptic solutions irritate the conjunctiva to a greater or less extent, producing hypersecretion. They are, therefore, inferior for douching purposes to physiological saline solution, which allows free irrigation without irritation. Such experiences, supported by subsequent clinical results, have made me seek to irritate the conjunctiva as little as possible, since the nearer the conjunctiva is to its normal condition the better for operative interference, believing, as I firmly do, in the truth of the old adage, let sleeping dogs lie.

With regard to the cases in the first series of experiments that proved to be septic, one important point was noted, namely, that such patients were all well over the age of sixty, while the cases that appeared aseptic were under thirty-seven years of age, with the exception of one case aged sixty-six. From this we may infer that the older the patient is the more difficulty one has in making the conjunctiva aseptic. This is an important

point in connection with operations for senile cataract, seeing that these cases are generally over sixty years of age. A further point worthy of note is that the duration of the preparatory cleansing is not so important in producing asepticity of the cul-de-sacs as might be expected, for one case, aged sixty-seven, produced dense turbidity of the broth in a couple of days, after seven days of sublimate solution, while the aseptic case, aged sixty-six, had only four days of preliminary cleansing. Now if the *Staphylococcus pyogenes aureus* and *albus*, the *Streptococcus pyogenes*, and various other forms of pyogenic bacteria be frequently found in the conjunctiva, and if we cannot rely on their removal before operating, especially in old people, how is it that we do not see more cases of corneal suppuration? Any pyogenic bacteria growing in the conjunctiva will have their virulence considerably attenuated on account of the unsuitable nutriment contained in the normal conjunctival secretions. We know that tears form the principal part of the fluid found in the conjunctival cul-de-sacs, and as they contain but 1 per cent. of solids, of which a small part only is proteid in nature, we cannot regard them as in any way a suitable nutrient medium. Further, the irrigating action of the tears must also play an important part in removing not only the organisms from the wound, but, what is more important still, their chemical products.

Having thus indicated the important points in the aseptic treatment of wounds in ophthalmic surgery, my experience of its application may be summed up thus:— It is now a little over two years since I adopted asepsis in all my operations, and during that time I have done a fair share of operative work, including about 100 cataract extractions and some thirty exsections with advancement. My cataract cases were by no means selected, and many of them were operated on before maturity. One case had a well-marked facial eczema, two intractable ozæna, and a few had chronic conjunctivitis. All my operations have healed by first intention, without the slightest

suggestion of suppuration, save in one alcoholic case, where the patient became very unruly, and on successive days against orders left his bed, walked along a corridor to the water-closet, and there tore off his dressings.

In the healing of cataract cases I find, as a rule, only a trace of conjunctival injection at the first dressing, sometimes not even that, except at the seat of the wound, and in short I am convinced that the period of healing is shorter, and that there are fewer interruptions in the healing process than when I employed antiseptics.

If, then, the methods I have advocated be carefully adhered to, the surgeon may rest assured that his injured tissues have been left as nearly as possible in their physiological condition, so that any micro-organisms present will be kept at bay by the inherent antiseptic properties of the tissues themselves. Such at least clinical experience in asepsis leads me to believe.

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The PRESIDENT said he thought all would agree that the paper was an important one. He felt they ought not only to congratulate the author on it, but also sympathise with him on account of the time-limit having compelled him to omit the reading of some portions of it. He, personally, would be glad to put into practice the views which Dr. McGillivray had expressed, more especially as his practice had for a long time been not far removed from that which the author had described. He had been using a sublimate solution of 1 in 10,000, which was in truth hardly worthy of the name of an antiseptic.

Mr. ARNOLD LAWSON said he would like to join issue with the author on the subject of micro-organisms found normally in the conjunctival sac. It had constantly been asserted that the conjunctival sac was the nidus for a number of pathogenic organisms, such as those Dr. McGillivray mentioned, viz. the *Staphylococcus pyogenes aureus* and *albus*, streptococci, and others; but speaking from experience he could state that it was not so.

During the last few months he had been engaged in examining the conjunctival sac with a view to determining the number and varieties of micro-organisms normally found in that situation. He had already completed the bacteriological examinations of ninety-six cases. They were all normal cases, both subjectively and objectively. The conjunctiva was smooth and normal in colour, no blocked ducts, no symptoms of pricking, and no gumming of the eyelids in the morning. In only two of those cases had he found *Staphylococcus pyogenes aureus*, and one of those cases he was doubtful of as to whether it was a normal conjunctiva. In fifteen or sixteen of the cases he had found other micrococci, such as the *Staphylococcus pyogenes albus*, but it was probable that they were instances of a non-virulent variety known as the *Staphylococcus epidermidis albus*. The only *biological* difference was that the liquefaction of gelatine was much slower in the latter, and that was why it was so often confused with the pathogenic variety. He would have more to say on the subject at some future date, but he thought he had examined a sufficient number of cases so far to be able to say that it was the exception, not the rule, to find pathogenic organisms in the normal conjunctival sac. Uhthoff and other bacteriologists who had paid attention to this point denied that the streptococcus was ever present in the normal conjunctival sac. Therefore the question of antiseptics in surgery seemed to be reduced to one of simplicity. Supposing the sac to be normal when operated on, there ought to be no suppuration, unless it were from organisms present in the ward or bed at the time of the operation, or in the dressings, instruments, or surgeon's hands, which were not aseptic.

Mr. Mackinlay said he had for years adopted the method of boiling all his instruments before operating for cataract, and having it done in his own presence. Sometimes he had used aseptic substances to the eye, and sometimes not, but the only lotion he used in dressing the eye was a saturated solution of boracic acid.

Mr. Bronner said he thought the ordinary surgical method was to adopt antiseptics before the operation, and asepsis at and during the operation. He did not think that in ophthalmic surgery they could possibly always have an aseptic operation, because the wound was subject to the secretion and contents of the lacrymal sac and conjunctival sac. He therefore still believed they ought to adopt antiseptic measures during the whole time, because they could not be certain that the fluids coming in contact with the wound during and after the operation were aseptic. A point of some importance arose out of the advocacy of boiling the knives, viz. that in hospital it was impossible to have a sufficient number of knives sharp enough, the boiling spoiling the delicately sharp edge.

He would like to ask Dr. McGillivray a question as to the use of cocaine on the eye. His own experience was that a wound to which cocaine had been applied suppurated more freely than it otherwise would. He had found that to be the case with ulcers and traumatic wounds. Of course suppuration in connection with cataract extraction was very rare, but he maintained that no ophthalmic operation could be called aseptic, because of the uncertain nature of the fluids which came in contact with the wound.

Mr. Bickerton said he would like to add his meed of congratulation for the excellent and thoughtful paper they had just heard. His predecessor in Liverpool, Mr. Walker, always boiled his instruments before operating, and during the four or five years he was with him he never saw a case of suppurative inflammation in his private practice. Since that time he had always boiled his own instruments before and after operating. He used 1 in 5000 perchloride to irrigate the eye, and in his practice had only seen two cases of suppurative inflammation after operation, both of these cases occurring in hospital, where he had relied upon the house surgeon to look after the instruments. He intended to

give up his perchloride of mercury in future, and adopt the saline solution which Dr. McGillivray suggested. Nature was a very much better judge of what was best for the eye than we were, and if our irrigating fluids were of the same composition as tears it would probably suffice. Moreover, if Mr. Arnold Lawson were correct in his statement about the scarcity of organisms found in the normal conjunctival sac, the necessity for antiseptic lotions was still further minimised.

Dr. McGillivray, in reply, thanked the speakers for the kind way in which they had received his paper. He agreed generally with Mr. Arnold Lawson's remarks, but it was very doubtful if they found a normal conjunctival sac after the age of fifty. He was in the habit of applying a test dressing to the eye on the night of admission, and if it was found dry and unstained in the morning he assumed the eye was suitable for operation. In all the cases in which he had found micro-organisms in the cul-de-sacs the test dressing was stained in the morning. The question of boiling knives blunting their edges was one of much practical importance, but if they were boiled for two and a half minutes before operating the cutting capacity was not altered. He did not now require to sharpen his instruments oftener than when he used chemical disinfectants. He had no experience of cocaine in relation to suppuration, because he had not had suppuration. He thought it had been proved that the secretion from a normal gland (such as the lacrymal) was aseptic. His idea in adopting a normal salt solution was to imitate nature. He thought they were all agreed that private cases hardly ever went wrong, that it was the cases in hospital. He might plainly say that he did not believe in the co-operative principle in the use of instruments or operating theatres. Each surgeon ought to have his own theatre, his own instruments, and even his own nurses, and then hospital cases would be as successful as private cases.

As to the antiseptic solutions employed for douching

purposes, he thought they were not only useless for the purpose intended, but actually injurious to the cut tissues of the wound, inasmuch as they caused irritation, which tended to impair the natural immunity or antiseptic property of living tissues.

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4. *The probable rôle of heredity in the development of myopia.*

By Charles Wray.

That refraction is bound up with heredity admits of no doubt, but its method of action is obscure. Willfuhr found it in the family in 376 out of 1352 cases of myopia, and Professor Velcker in 174 out of 257 in his private practice, and there can be no doubt it was present but not traceable in no small proportion of the 83 remaining cases. My own experience is that it is exceptional to find it without the same condition being present in some blood relation.

A few words are necessary on family history, as it is of immense importance in the study of the causation of myopia. Inquiries on refraction are generally limited to that of parents, brothers and sisters of parents, and brothers and sisters of patients. Galton has calculated that we derive one fourth of our hereditary tendencies from each parent and one sixteenth from each grandparent. That such may be derived from remote ancestors is certain, but in that case if a myopic ancestry is traceable in so many instances without ascertaining the refraction of grandparents and great-grandparents, how many more would show predisposition could we but go a generation or so further back!

A frequent source of error in statistical tables is that the refraction of cousins is taken into consideration, although their myopia may have been derived from a parent or ancestor who is no blood relation of the patient.

After these preliminary remarks on family history we are brought to the vexed question, Is all myopia transmissible? No one questions the transmissibility of ordinary myopia, but the evidence of the transmissibility of acquired myopia is far from clear.

The above remarks on family history will show how necessary it is to be cautious in the use of the term "acquired myopia," for it is always an instance of taking for granted what has to be proved and is incapable of proof.

The transmission or non-transmission of all myopias is at present one of the most vexed questions in ophthalmology. Weismann uncompromisingly repudiates the possibility of the transmission of purely acquired structural conditions; and Galton, whilst taking up a less decided attitude, has not seen his way to give the weight of his authority to the other side. Seeing it is impossible to prove that myopia may occur in the absence of hereditary predisposition, it simply remains to discuss its chances of transmission in the event of its being actually acquirable. The evidence is *quasi*-experimental and experimental.

The *quasi*-experimental evidence is furnished by the failure of the ancient rite of circumcision to effect any change in the foreskin of Jewish babies.

As regards experimental evidence, Milder enucleated one eye of rabbits for many successive generations during several years, but never saw a one-eyed rabbit born when the operation had been conducted aseptically.

These points weigh strongly against the transmission of acquired myopia. They are to some extent discounted by the fact that Motais and others have noted an increase of myopes in the progeny of wild animals after several generations of captivity; but this is not evidence of purely acquired myopia, for many wild animals are myopic, and many more on the borderland of myopia. Heredity here may be the predisposing cause and the weakened bodily condition from an unnatural life, the

cause which finally passes the refraction from the borderland to actual myopia. At any rate, it is not clear that heredity was not a necessary antecedent.

With regard to the effect of heredity on the amount of refraction, my experience is that the marriage of hypermetropes with myopes, and myopes with myopes, acts by increasing the number of myopic progeny; but there is no relationship between the amount of myopia in a child and the sum of dioptres of myopia possessed by his myopic parents. The most important result of my analysis of hospital and private cases is that I do not seem to have seen one case in which *two* myopic parents have begotten a child with more than 7 D. of myopia. Myopes of 20 D. seem never to have traceable ancestors with more than 7 D.

How is the existence of 20 D. myopia explained? Is it necessary to assume this is entirely due to heredity? Out of 24,000 eye cases I only found 126 cases of myopia over 10 D. The investigation can only be approached by the indirect method of ascertaining if a condition was markedly present in the patients, and as obviously absent in their brothers and sisters. In about one half the cases occurring in children I ascertained that the patient had suffered from prolonged infantile marasmus, whilst the others had escaped, and feel there is reason to believe that extra- and intra-uterine marasmus may have a causal relation to high myopia. If this be the case, then the treatment of infantile marasmus would become a matter of great urgency when occurring in the offspring of myopic parents, where hereditary predisposition would be more or less strong. Marasmus is not, however, the sole explanation of highest grade myopia. If it were the affection would almost invariably be binocular, which it is not. How then can it be explained when occurring on one side only? Hereditary predisposition is fairly constant and traceable, but evidently some condition exists on one side of the body which does not exist on the other. It is exceedingly rare to find such extra-

ordinary disproportion between opposite limbs; and if so, what conditions are likely to account for this? Heredity has the same scope in each case. There is, however, a difference in the developmental history. The key to the solution of the difficulty is not improbably to be found in connection with the passage of the mesoblastic elements into the secondary optic vesicle to form the vitreous. Hypo-inclusion might be expected to give rise to a small eye, and excessive inclusion to the myopic type. On this calculation, seeing that the vitreous grows during the growing period, eyes that have included a small excess might be expected to be hypermetropic in early life, and to become myopic later on. Stationary hypermetropia and myopia would depend upon maintenance of ratios, and non-stationary hypermetropia and myopia upon non-maintenance of ratios. There seems to be much uncertainty as to the change of refraction after birth; some authorities state it to be about 3 D. within the first five years, and others as dogmatically teach that refraction, as a rule, does not change. It is probable the compensation changes for increase in the posterior segment are mostly corneal. When inadequate, then increasing refraction is the rule. With excessive inclusion it is plain that the eye will be less easily moveable, and the resultant action of the muscles will be severely felt at the posterior pole. If the essence of myopia-genesis consists in excessive inclusion without regard to choroid, then the latter may be comparatively unequal to its requirements, and it, like the vitreous, will be unstable. Time will not allow me to present this theory in detail, but the sketch already given will suffice to show that the idea is not far-fetched or unreasonable.

(*November 11th*, 1897.)

The Chairman (Dr. Berry) thought the subject was sufficiently theoretical to tempt discussion. One consideration was as to whether all cases of myopia really were hereditary, whether a distinction was not to be made

between the ordinary form of myopia and the type which was associated with disease. As far as his own experience went, the latter did not appear to be nearly so dependent upon an hereditary condition as the former.

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5. *On the function of the rods of the human retina with a reference to the allied theory of von Kries.*

By August Breuer.

I have no desire to augment the number of the already numerous hypotheses that have been promulgated besides the well-known theories of Young-Helmholtz and Hering, but I should like to communicate some lately discovered facts, which greatly modify our views and increase our knowledge regarding our visual apparatus. Among these are the following, which I mention in chronological order of discovering.

1. Purkinje's phenomenon, *i. e.* the shifting of the most luminous part of the spectrum towards the more refractive end, when the eye is adapted for the dark and we observe at a lower illumination.

2. Hildebrand established that to the eye, when well adapted for the dark, a feebly illuminated spectrum appears colourless, and besides that the greatest luminosity is transferred from yellow to the green.

3. König found that the decoloration of spectral light does not take place in small fields of observation which are directly viewed.

4. Von Kries was the first to state that Purkinje's phenomenon does not exist at all for the macula lutea.

It is a long-established fact that feebly illuminated objects appear more distinct when viewed with the periphery of our retina. This is well exemplified in the group of stars called Pleiades, belonging to the fifth order, which can scarcely be individually distinguished when viewed directly, but is easily seen to consist of

six in indirect vision. This relative superiority of the periphery of the retina over the centre holds good for light of short wave-length only, which then appears colourless; red is therefore excepted. Briefly summed up, this special kind of vision is characterised by—(1) its inability to distinguish colours; (2) a very pronounced sensibility for weakly illuminated objects; (3) a preference for rays of medium and short wave-length; (4) its total absence in the macula lutea.

Anatomy has long since taught us that the rods are also absent in the yellow spot. Schultze published in 1866 that animals which exercise their activity by preference at night are comparatively destitute of cones.

It is on the base of these facts that Von Kries came to his conclusion that an interesting and simple division of function seems to exist between the apparatus connected with rods and cones respectively. According to him the latter, the cones, form a trichromatic apparatus, *i. e.* capable of distinguishing the spectral colours, and requiring for its exercise higher intensities of light, and resulting in greater definiteness and clearness of perception. The rods, on the other hand, constitute an apparatus adapted for exercise of function at far lower intensities of light, with the natural drawback of ability merely to distinguish between light and dark, and not between colours. The result is a lack of clearness and definiteness in perception. Generally it is the cones that are exercised in strong light, and the rods in weak. It must be remembered at the same time that the function of the one is not absolutely denied to the other, only that the sensations produced under certain conditions by the one are far more pronounced than those produced under the same conditions by the other.

Before mentioning further facts in support of the above theory I should like to communicate to you a series of observations made by myself, with the object of affording a more definite illustration of the function of the rods. For this purpose the following arrangement

was devised. A dark room contains an upright board covered with black velvet, and presenting a circular luminous aperture of $\frac{1}{3}$ mm. in diameter, serving as point of fixation. At the same level with this point two circular discs of white paper (3 mm. in diameter) could be moved in horizontal direction on a slide just in front of and in the same plane with the board. These two objects were illuminated by a small gas flame of constant intensity placed behind the observer, the yellow colour of the gas-light being rectified by a blue chimney. The observer's eye was 50 cm. distant from the fixation point and the white discs. By varying the distance of the gas-flame the intensity of illumination was ascertained at which one of those objects just remained visible at direct fixation with the macula. The intensity of illumination gave the lowest stimulus required for visibility by direct fixation, and occurred when the gas lamp was distant 44 cm. from the disc, and the eye had been in the dark for five minutes. After a longer adaptation for the dark the lowest stimulus for central vision appeared always increased, *i. e.* the distance of the lamp had to be diminished. After further adaptation the lowest stimulus was ascertained at which peripheral visibility took place, the objects being no longer visible at direct fixation. For this purpose the observer's glance had to be directed towards the aperture as fixation point, while the discs were viewed peripherally, the distance of the lamp being slowly increased. It was found that the lowest stimulus required for peripheral vision decreased with increasing adaptation for the dark. For instance, after adaptation of twenty minutes' duration it was found that the disc could be peripherally seen at an illumination 180 times weaker than that necessary for central vision; after still further adaptation the required stimulus was afforded at an illumination 300 times weaker. The lowest stimulus for peripheral vision ever recorded was 360 times smaller than that required after short adaptation for central vision.

An attempt was made to measure the diameter of the field within which the discs disappear at weak illumination and after adaptation for the dark. For this purpose the lowest illumination at which central vision was obtained was diminished, the observer had to fix his glance on the fixation point, while the discs were slowly glided towards it from both sides, until they just disappeared from sight. By this means a well-defined area could be determined. After having diminished the illumination by one half, the diameter of the field was equal to 15·45 mm., corresponding under the given conditions to a visual angle of 1° 43′. By further decreasing the intensity of illumination, the area of central disappearance increased, but in an irregular manner, so that it is impossible to find a numerical expression for the relation.* The average results of a great number of observations are, however, appended in the following table.

Area of central disappearance of the objects.

Distance of the lamp.	In millimetres projected at 0·5 metre.	In visual angles.
1 metre	... 22·6	... 2° 33′
2 metres ...	... ... 35·0	... 4°
3 „	... 56·0	... 6° 25′
4 „	... 67·0	... 7° 41′
5 „	... 75·0	... 8° 36′
6 „	... 87·0	... 9° 59′

This table shows distinctly that the sensibility of the retina increases by dark adaptation from the centre towards the periphery. As further observations on the lines described above appeared too uncertain because of the extreme feebleness of illumination that had to be employed, the following method was pursued :—The white objects of 3 mm. in diameter were placed at points in a horizontal line, and in the same plane

* For further details the following paper may be consulted : " Ueber die absolute Empfindlichkeit der vaschiedenen Netzhautheile im dunkeladaptirten Auge," A. Breuer and A. Pertz. 'Zeitschr. der Psychol. et Physiol. der Sinnesorgans,' vol. xv, 5.

with the black board, corresponding to 6°, 12°, and 18° from the macula respectively; the illumination was varied by increasing or decreasing the distance of a plane mirror which reflected the light of the gas flame upon those objects. The observer looked steadily at the fixation point, while the assistant slowly moved the mirror on a slide nearer to this point. The first object to become visible was the one 18° distant; very shortly afterwards or almost immediately the second object, 12° distant, appeared; but a much longer interval took place before the appearance of the third object. This fact and the results of the previous table show that the increase of retinal sensibility, or of the sensibility of the rods according to von Kries, is distinctly marked up to a distance of 12°, but between 12° and 18° is very slight. All these observations were made after a dark adaptation of thirty minutes, and the average figures of more than thirty observations are appended below.

In the temporal part of the vision-field, the object 6° from macula became visible at a distance of the mirror of 1·52 metres; 12°, 1·74 m.; 18°, 1·95 m. In the nasal part, 6°, 1·73 m.; 12°, 2·03 m.; 18°, 2·10 m.

If the light of a gas flame is made to pass through a saturated solution of bichromate of potassium, so that almost none but the red rays pass through, the increase of retinal sensibility from the centre towards the periphery falls far short of that experienced in the case of white light. In order to obviate disturbing influences by retinal fatigue, care was always taken that the times of observations should be very short, about two to three seconds; during the intervals the sight being directed to another point of the black board, or the eyes being kept closed.

From these observations we are induced to draw certain conclusions respecting the anatomical size of the area free from rods in our retina. This, however, cannot be done with any certainty because of constant variations in the size of the field within which those objects

disappear, depending upon the intensity of the illumination and the degree of the dark adaptation. By choosing for the estimate of the central rodless area the illumination given at a lamp distance of 1 m., being an illumination decidedly below the stimulus necessary for activity of the cones, the area of central disappearance is 22·6 mm. According to the reduced eye of Donders (anterior-posterior diameter 20 mm., nodal point 5 mm. behind centre of cornea) we get the following equation: $22 : x = 505 : 15$, therefore x (representing the area free from rods in the retina) = 0·64 mm. As anatomical investigation has shown, there is in the retina no clear line of demarcation between the district occupied solely by cones and that in which rods begin to appear. According to Koster ("Études sur les cones et les batonets dans la région de la fovea centralis de la rétine chez l'homme," 'Arch d'Opht.,' 1895) the breadth of the area in which we find practically nothing but cones is 0·8 mm. From this limit rods gradually become more numerous, and outside an area 1·84 mm. in diameter rods outnumber the cones, and are arranged in groups round them. These figures, arrived at by anatomical observations, seem to harmonise with those arrived at by myself in physiological observation.

To demonstrate the soundness of the theory of Von Kries regarding the duality of our visual apparatus, facts may be mentioned of a more conclusive nature still. There is, for instance, the interesting phenomenon of recurrent vision, for the characteristics of which I refer to the papers of Young ("Note on Recurrent Vision)," Davis ("On Recurrent Vision," both in 'Philos. Mag.,' 1872), Bidwell ("On the Recurring Images following Visual Impressions," 'Proceedings of the Royal Society, 1894'), and to publications of Exner, Hess, and Snellen If we observe a luminous point passing over our retina while our glance is fixed, we see the first impression of light after a distinct interval of dark, followed by a second impression. After a short dark

adaptation (four to five minutes), and by using coloured objects, the second impression appears of the complementary colour. Von Kries showed that if this peripherally viewed appearance is made to pass through our fixation point, *i. e.* for a moment centrally viewed, the second impression suddenly disappears. Different attempts to measure the area within which the second impression disappears gave a diameter of thirty-five to thirty-eight mm., projected at one m., corresponding in the human retina to a field of 0·52 mm. Further, he found that after a long dark adaptation (two hours) the whole appearance is totally altered. The recurrent image is no longer visible; directly attached to the primary one appears a brilliant white band, of different lengths according to the intensity of the light used. This may be observed with light of any colour except red. The first explanation that suggests itself is that both the recurrent image and the brilliant white band correspond to a reaction of the retinal rods, these after a long adaptation producing a modified colourless and stronger impression. This explanation, however, is not sufficient, as such a postponed reaction of the rods cannot be assumed. A series of experiments carried on by Nagel and myself working in conjunction showed that with feebly illuminated blue signals, disappearing in central vision, the time of reaction was very little postponed, certainly less than one fifth of a second. Although we are up to now unable to give a full explanation as to the nature of recurrent vision under these different conditions, the whole phenomenon points to a duality in our visual apparatus, as it is represented anatomically by the division of the percipient retinal elements into rods and cones. It is interesting to note that the recurrent image could not be perceived by a patient with complete congenital colour-blindness.

In corroboration of this theory we have further facts connected with the observation of colour equations, at first with strong illumination, as daylight, and small fields of observation, then with feeble light and dark adaptation;

in other words, are colour equations dependent upon the intensity of illumination or not? The dependence of colour equations upon the light intensity and the adaptation of the eye is fully demonstrated in von Kries and Nagel's publication "Ueber den Einfluss von Lichtstärke und Adaptation auf das Schen der Dichromaten," 'Zeitschrift für Psychol. und Physiol. der Sinnesorgane,' 1896. The whole spectrum was systematically examined by a dichromat (red-green blind), who found for each homogeneous light the quantity of red (645 $\mu\mu$) and blue (460·8 $\mu\mu$) necessary to form an equation. These equations were formed at first at a strong light and with small fields of observation (less than 2°), then after dark adaptation and with large fields, colours being then indistinguishable. Briefly, the first ones may be called light equations, representing chiefly the effect upon the cones; and the latter dark equations, representing chiefly the effect upon the rods. From the foregoing remarks it may be assumed that both forms of equations appear distinctly different, and in this respect, that the part representing the greater stimulus for rods showed a remarkable superiority of luminosity. Still more striking is the following experiment, mentioned first by von Kries. A dichromatic person is able to make a colour equation between 495 $\mu\mu$ that appears colourless to him, and another colourless mixture of red and blue. At feeble illumination and dark adaptation this equation becomes untrue, the homogeneous light appearing much more luminous. This fact is very conclusive, as comparison between intensities of light only is required, both parts appearing colourless. Further, the existence of an independent rod or dark apparatus can here be demonstrated without reference to the isolated reaction of the macula. The field is on both occasions observed by the same extramacular spot of the retina.

These differences, great as they are, as well as those existing between red and green blind persons, Hering tried to explain by absorption through the yellow pigment

of the macula. I willingly complied with von Kries's request to obtain by direct examination a numerical expression for the effect the macular pigment produces upon colour equations. Through experiments made by Sachs ("Ueber die specifische Lichtabsorption des gelben Fleckes der Netzhaut," 'Pflüger's Archiv,' l) we know in what proportion this pigment absorbs light of different wave-length. As all those observations were made on excised prepared retinæ, they give, as Hering states himself, only a qualitative definition of the pigment. A more quantitative estimate will be reached by comparing colour equations obtained by direct macular vision with those obtained by employing extra-macular parts,—briefly named, comparison of central and paracentral equations. The basis of such observations is the fact that a homogeneous light is altered by the absorption quantitatively but not qualitatively. As an illustration, suppose a homogeneous orange appears in paracentral vision equal to a mixture of 1 part red (670·8 $\mu\mu$) and b_1 green (517 $\mu\mu$), but in central vision the same homogeneous orange requires in addition to 1 part red b_2 green, we can conclude that the absorption by the macular pigment—when affecting red in the proportion of $1 : a$—reduces green to the fraction $a\,\frac{b_1}{b_2}$. If in paracentral vision the equation is 1 red + b_1 green = c_1 orange, and in macular vision 1 red + b_2 green = c_2 orange, then, if the reduction of red = a, that of green is $a\,\frac{b_1}{b_2}$ and that of orange $a\,\frac{c_1}{c_2}$. As light of long wave-length does not undergo any appreciable absorption by the macular pigment, and it is unnecessary to bring this constant co-efficient into account, we assume $a = 1$. This process gives the relative absorption not only of the green mixed with red, but also of the homogeneous light compared with the mixture. The equation for central fixation was formed on a field of 1° in diameter, the equation for indirect fixation on a field of 3° diameter.

Three degrees distant from the latter a small luminous point was reflected to serve as fixation point, so that the field covered an area 3° to 6° distant from the centre of the macula. It was desirable to estimate at first the reduction of the green (517) by mixing it with red (670), and making the mixture equal in hue, luminosity, and purity to different homogeneous lights of intermediate wave-length. Next the absorption of blue (460·8) relatively to that of green was estimated by comparing again a mixture of green and blue with intermediate homogeneous lights. The total absorption of the blue was then found by simply multiplying together the two previous results. Space forbids me to enter upon a more detailed account, but those who are interested in the matter I refer to my publication ("Der Einfluss des Maculapigments auf Farbengleichungen," 'Zeitschrift für Psychol. und Physiol. des Sinnesorgane,' 1897). The average absorption of green (517) obtained from a long series of observations was equal to 0·77, that of blue (460·8) relative to that of green 0·7. Therefore the total absorption of the blue, which is the colour absorbed most, amounts to 0·54. It is interesting to note that these results differ very slightly from those obtained by Sachs, who examined maculæ luteæ of excised retinæ. The latter vary for light 486 $\mu\mu$ from 0·656 to 0·786. I may also mention that, compared with the numerous investigations carried out in the physiological institution of the University of Freiburg, the pigmentation of the macula lutea of my own eye was slightly below the average amount, but by no means the least. We cannot hope to express by means of a curve or give a numerical expression for the amount of absorption at each spot in proportion to its distance from the centre, but for practical purposes I consider the above results perfectly sufficient. As I have demonstrated above, the sensibility of the periphery of the retina is greatly increased by adaptation for the dark, especially with light of short wave-length. The question might be raised whether the

lowered sensibility of the centre is due to the presence of the pigment. Results as above obtained are quite inadequate to decide this point. For instance, if we find that the lowest stimulus at a distance of 3° from the centre is equal to one twentieth of the stimulus necessary for central vision, we are justified in saying that the absorption by macular pigment cannot be made responsible for the increase of peripheral sensibility, and some other explanation, such as a twofold function of our visual apparatus, must be looked for. Although these investigations may not seem to be of much value in practical ophthalmology, yet it is clear that they will afford great help in the examination of any derangement of visual functions such as are exhibited by the different varieties of colour-blindness or idiopathic hemeralopia.

(*January* 27*th*, 1898.)

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6. *On ophthalmoscopic evidence of general arterial disease.*

By Marcus Gunn.

(With Plate XI.)

It will be understood from the title of this paper, that I do not propose to consider alterations in retinal arteries generally. My object is, in the first place, to describe certain ophthalmoscopic changes,—all, I believe, dependent primarily on an affection of retinal arteries; and secondly, to give my reasons for this belief, and for the opinion that such visible primary changes in retinal arteries are very commonly, if not constantly, a part of a similar, more general, and therefore more important change in small arteries elsewhere.

Some six years ago I showed two patients at this Society illustrating these fundus changes, and I may be permitted to quote shortly from the description then given:—"The arteries have an exceptionally bright re-

flex; the central light-streak is very distinct and sharp, while the whole surface of the vessel is of a somewhat lighter colour than usual. This condition has been observed in many cases of chronic albuminuria, and in several cases where no albumen was found, but where high arterial tension suggested the probability of changes in the arteries similar to those usually associated with chronic renal changes. The ophthalmoscopic appearance is presumably due to hyaline degeneration of the arterial walls. Attention is also directed to the effect produced on the veins by arteries overlying them. Where an artery, even a small twig, passes over a retinal vein, the circulation in the latter is much impeded. In some cases the vein is indistinguishable just at the spot where it is crossed, and is evidently distended for some distance peripherally from this point."

Since the time of that communication I have seen a considerable number of such cases, and was soon impressed by the frequent association of these changes with manifestations of cerebral vascular disease.

The ophthalmoscopic appearances in an advanced case include arterial changes, signs of mechanical pressure on veins, œdema of the retina, and retinal hæmorrhages.

(*a*) As regards the *retinal arteries* attention is to be directed first to their *size* or *breadth*. In the condition under consideration the arteries are usually abnormally narrow, but the chief peculiarity as regards size consists in the irregularity of their breadth. On following a vessel of apparently normal size we may find that at one point it rapidly contracts and continues very narrow for some distance, when it will again broaden out and regain its original breadth; or there may be a local increase in breadth, the artery tapering off at either extremity to the normal, or even to a part that is subnormal in width. Such a local dilation of artery is occasionally met with in the macular region, where it at once attracts attention from the unaccustomed appearance of a large bright retinal vessel in this locality. It is impossible to say

positively ophthalmoscopically how far such variation in breadth represents an actual difference in calibre of the blood-carrying tube, but I believe that the latter varies more or less directly with the apparent size in these cases, and that we can fairly correctly judge the breadth of the artery by the breadth of the blood-stream that gives us the red reflex. It is of course different where the coats become opaque in disease; a narrow red reflex from such a vessel may be no gauge of the actual blood-stream, and its opaque walls are visible enough, giving us simply the reflection from their white fibrous tissue.

(*b*) Secondly, the arteries very often follow an *unusually tortuous course*. This character is only of importance when existing along with other evidences of disease, as it is not uncommon to meet with an excess of tortuosity merely as a congenital condition.

(*c*) *Reflex*.—The central light-streak is narrow and exceptionally bright. Sometimes this bright line is not quite uniform, but on careful examination can be seen to show a series of brighter points at intervals. An increased sheen from arteries may be met with without the other signs, *e. g.* in high hypermetropia, after optic neuritis, and sometimes without any evident cause; in such cases the bright reflex is chiefly noticed on and near the optic disc. But in the condition now under consideration it is not merely in this neighbourhood that the arteries show the bright reflex; in fact, it is usually the secondary and tertiary branches of the central artery that are mainly affected. Some branches may show it more markedly than others in the same fundus. Further, the entire breadth of such arteries seems abnormally light in colour, as if there were an unusual reflection from their coats, and not merely an increased brightness of the central streak. The whole effect is to give the impression of unusual fulness and roundness of contour.

(*d*) *Loss of translucency*.—In health, the retinal artery, with its contained blood-column, is sufficiently translucent to permit of an underlying vein being detected through it.

PLATE XI.

Illustrates Mr. Marcus Gunn's paper on Ophthalmoscopic Evidence of General Arterial Disease (p. 356).

(From a drawing by Miss Brook.)

Arterial changes such as are described in the paper are seen in this case. There is some general œdema of the retina, and there are localised hæmorrhages and spots of degeneration. The veins, when crossed over by arteries, have their circulation impeded. This is strikingly exhibited in a large upper temporal vein, where the obstruction has led to marked tortuosity and to secondary changes outside the walls of the vein.

M. H. Brooks, del.

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This is especially well seen in the eye of the young. One of the earliest indications of change is loss of this power of transmitting light, and the difficulty is soon increased by a manifest pressure on the underlying vein—the sign next to be noticed. In the case of an overlying vein the opposite effect seems to be produced. Normally, in consequence of the darkness of the venous blood-column, an artery is invisible through a vein; but in advanced stages of this arterial change the underlying artery can often be seen. This is presumably due partly to the arterial reflex being brighter, and partly to the thickness of the venous blood-stream being somewhat less at this point, as we shall see presently.

(*e*) *Influence of the arterial pressure on the venous blood-stream* where the artery and vein cross one another. A diseased artery of this kind soon shows the influence of its pressure on the underlying vein. At first this is but slight, indicated by the vein losing its central light-streak on either side of the crossing, and sometimes by its being

FIG. 30.

a *b* *c*

Shows diagrammatically, different appearances presented by a retinal vein where crossed over by artery. *a*. In health; the underlying vein dimly traceable underneath the artery. *b*. In early stage of arterio-sclerosis; the vein somewhat displaced in direction of arterial circulation (indicated by arrow), and its flow slightly obstructed. *c*. In advanced stage of the same; the vein greatly narrowed where crossed, and distended on peripheral side.

slightly pushed to one side. Later the venous current is markedly impeded, and there may be no apparent venous blood-stream where the arterial pressure is exerted, while peripherally the vein is abnormally engorged. When the

vein lies above, that is on the vitreous side of the artery at the crossing, the venous current is less interfered with. The vein may then simply be flattened out, losing its central streak, and not infrequently permitting the arterial sheen to be perceived through it. It is obvious, however, that even a normal artery may obstruct the venous flow where the vein is turgid from some other cause, as *e. g.* in cases of inflammation of the optic nerve and retina.

(*f*) *Œdema of the retina.*—It is common to find a want of the full red fundus-reflex, rendering the examination very unsatisfactory without mydriasis. In the absence of any opacity in the media sufficient to account for this condition, œdema of the retina presents itself as a probable explanation. Sometimes it amounts to a decided grey haze that there can be no question about, and this may be best marked in the macula or over the distribution area of one retinal blood-vessel. Hæmorrhages also may be present, particularly in cases where the veins are very full and where there is marked œdema.

It is only when several of these signs that I have described are present together, that we can assert positively that the arterial change is in reality very important. The ophthalmoscopic observation of these changes in the fundus demands no great skill, and I believe that we have here a ready and valuable means of diagnosing a general disease that is otherwise often very difficult to detect.

What is the explanation of these appearances? The apparent diminution in size of the arteries is, I believe, associated with changes in the coats, which have narrowed the blood-stream. Such changes are rarely here accompanied by so much fibrous thickening as to lead to the appearance of white lines along the vessel. Inasmuch as the disease affects some parts of the artery more than others, we have as a result irregularity in calibre, and this has been found to characterise arterio-sclerosis in other parts of the body. Associated with these changes in the coats, the arterial walls lose their elasticity and

become abnormally rigid, and doubtless in this way, as well as by actual narrowing, the blood-current is impeded, and the tortuosity may be regarded as the result of the *vis a tergo* acting upon a tube that has lost its normal carrying power. The slight opacity of the coats is explained by the pathological changes already indicated, and the brightness of the central light-streak is also, no doubt, mainly due to the higher reflecting power from the arterial wall after it has undergone a hyaline-fibroid change, and partly also possibly to an increased tightness of the artery itself. The influence of the artery on the vein at the point of crossing is to be accounted for by the rigidity of the altered arterial coats, aided possibly by an increase in the pressure of the blood contained in the artery. The result of the increased difficulty in arterial circulation will be to diminish the rapidity of the blood-stream in the capillaries and veins. As a result, there will be a tendency to the escape of *liquor sanguinis* into the surrounding tissues, and this tendency will be much increased where the venous circulation is mechanically impeded, as by an overlying artery.

From a persistence of such an œdema the nutrition of the blood-vessels will undoubtedly suffer. In this way not only may the arterial changes progress more rapidly, but the walls of the capillaries and veins being also involved and rendered more permeable, a diapedesis of blood-cells takes place, and we get hæmorrhages and white patches in the retina. In the most advanced cases the lines of the folds which radiate from the fovea centralis, due to the œdema, are sometimes eventually marked out by the deposit of white spots of degenerated effusion, so that we get the ophthalmoscopic appearances diagnostic of so-called albuminuric or renal retinitis, though in the variety now under consideration the condition may exist only in one eye, and may not be accompanied by albuminuria.

Ætiology.—I merely desire to indicate the kind of patient in whom these retinal appearances have been

found. If, as I contend, this retinal change is in reality part of a widely spread arterial disease, its causation is a question for the physician.

Old age alone does not produce these changes. I have often seen healthy-looking retinal vessels in people seventy to eighty years of age. My impression is, however, that the visible changes begin usually between forty and fifty in those disposed to their occurrence, and increase more or less gradually thereafter. As to the progress of the changes, much doubtless depends upon the care exercised; but if they are present at the period of life mentioned, I believe the prognosis is unfavorable.

I do not know how far it may be mere coincidence, or whether it is more cause or more effect, but such cases have often suffered from migraine, sometimes with marked indigestion, and have had a life of exceptional worry, or perhaps I should rather say *worrying*. They frequently give a history of gout, personal or family. It may be that the primary cause is a form of poisoning produced by indigestion, a mal-assimilation and imperfect elimination producing disordered nutrition, and that the blood-vessels suffer in consequence. It is common, of course, to get migraine in quite young people with seemingly healthy vessels, and it is probable that the temporary recurrent toxic influence producing migraine only sometimes has a permanent effect on the arteries, and that after a long time. So long as the arterial coats are healthy, or moderately so, the irritant in the blood may provoke a contraction of the muscular coat, which it cannot effect so readily later when the tube becomes more rigid. In this way perhaps it is that migraine so often becomes less frequent, or disappears in later life. If this be so, the fact of its disappearance is not an unmixed benefit to the individual.

Chronic alcoholism must certainly be regarded as a strong element in the causation of this affection of retinal arteries. Again, as a predisposing cause, there may often be an atavism, a family tendency to arterial disease

of this character. Several of my cases gave a history in support of this.

As regards the possibility of its development being merely local, I have already referred to extreme brightness of arterial reflex being visible occasionally in high degrees of hypermetropia, and sometimes after recovery from an optic neuritis that has not been followed by visible nerve changes. This brightness seems due to a change affecting the adventitia only, probably a result of prolonged congestion of the disc; I have seen no reason to suppose that these arteries undergo later a more important degeneration, though such may be the case. Again, in post-neuritic atrophy the condition of the arteries sometimes closely resembles that I have indicated as regards the *narrowing* and *sheen;* but the narrowing is greater and more uniform, and the sheen is accompanied by evident new fibrous tissue formation.

It has been observed that irregularity in the calibre of the retinal artery is often associated with retro-ocular neuritis. In this I can quite agree, though the nature of the connection is doubtful. Is it some general blood-state that has affected the nutrition of both arteries and nerves? Or is the arterial disease *directly* connected with the neuritis? If so, is the arterial affection the cause or the effect of the change in the nerve? A certain number of these cases prove to have albuminuria, and in these it is fair to assume that the arterial affection is not merely local. The *arteria centralis retinæ* gives off one small branch shortly after entering the optic nerve. This branch supplies the axial fibres of the nerve near the papilla, and it is reasonable to suppose that its degeneration may affect the nutrition of these fibres, so as to produce the ordinary symptoms of a retro-ocular neuritis. Its size corresponds with that of the retinal branches that are commonly chiefly affected in this form of arterial degeneration.

As regards the *clinical significance* of these changes, I would remark that they are not uncommonly met with in

association with glaucoma, and that possibly they are responsible for the so-called hæmorrhagic forms of this disease. In two patients that I had seen with an advanced form of the affection in one eye, I find on inquiry lately that the eye had been excised in one case by myself later for pain and increased tension, and in the other case by another surgeon, presumably on account of the same condition. In support of this view I would also adduce the fact that Brailey and Edmunds* found the arteries diseased in sixteen out of seventeen eyes excised for hæmorrhagic glaucoma.

In several cases diagnosed as hæmorrhagic retinitis I have found the arteries of this type, and every indication of the retinal affection being in reality due to this cause, the veins, though full, being nowise suggestive of venous thrombosis. Further, diseased arteries of this kind are prone to arterial thrombosis, and many cases called *embolism* of the central artery or its branches show the described changes.

Again, I have been impressed by the frequency of lenticular opacities in eyes showing these arterial characters. We must bear in mind, however, how frequently the lens is involved in patients over middle life, and how much more readily we observe this when the eye is examined carefully after using a mydriatic, as has been done in these cases. Should there be a real connection it would rather, I think, point to the probability of the ciliary arteries being similarly affected, and the nutrition of the lens suffering in consequence.

The other complications met with include detached retina in four cases, and Tay's choroiditis several times.

The chief importance of this retinal arterial change, however, lies in its association with a more general arterial disease of a similar nature, particularly in the kidneys and brain; and in its prognostic value in regard to the results which may follow in cerebral vessels. It has been well said that "a man is as old as his arteries."

* 'Roy. Lond. Ophth. Hosp. Rep.,' vol. x, p. 132.

I would urge that ophthalmoscopic observation is one of the most ready clinical means for the early detection of important arterial changes.

As to the association of these retinal alterations with renal disease, it is very possible that the vessels of the eye and brain may occasionally be affected without those of the kidney being involved. We have to bear in mind, however, that granular kidney, associated with arterial sclerosis, is very often not accompanied by albuminuria. I certainly have not found albuminuria nearly so common in these patients as I at first thought was the case, and even when evidence of renal disease is present the kidney condition seldom proves of major importance. The cases that I have succeeded in following up indicate, as I have said, the more intimate connection between these ophthalmoscopic changes and later evidences of cerebral vascular disease.

Case 1.—Mr. Henry H—, æt. 62, came in September, 1890, from Mr. Maling, of Sunderland. He complains of failing sight for last two years; more rapid lately, sometimes with aching pain.

The R. E. has always been defective; squinted when a child. T. n. both.

R. E. V. $= \frac{20}{100}$ Hm. 2 D. $= \frac{20}{40}$. L. E. V. $= \frac{20}{200}$ barely, and $\bar{c} + 6$ D. can only read words of J. 8 with difficulty. With the L. E. he says the letters are distorted and "higgledy-piggledy."

Ophthalmoscopically.—L. E.: veins decidedly tortuous. O. D. margin blurred except outwards. Hæmorrhage and new vessels on inner side of O. D. One large flame-shaped retinal hæmorrhage at side of large vein below O. D. Slight œdema in macula. R. E.: several floating opacities in vitreous. Fundus shows no gross changes. His urine has been examined and pronounced normal.

In reply to inquiries, Dr. W. Robinson writes in February, 1898, "Mr. H— died about two years ago. He had a fit of cerebral apoplexy affecting the right side

of the body and affecting his speech, which he never quite regained. There were no renal symptoms."

Case 2.—Mrs. W—, æt. 50, came in June, 1889, on account of presbyopia. Her distant vision was normal in each eye. In both eyes, but in the left particularly, the veins were almost obliterated at each point where crossed by an arterial branch. No hæmorrhages.

On inquiring recently Dr. Aveling, of Clapton, wrote me saying that she died in September, 1890, from apoplexy, "no doubt cerebral hæmorrhage."

Case 3.—General H—, æt. 55, came in July, 1890, on account of recent failure of vision.

R. E. V. $= \frac{20}{30}$; $\bar{c} - 0{\cdot}5 = \frac{20}{20}$. L. E. V. $= \frac{20}{100}$, not improved.

His speech is peculiar; there seems to be some cerebral change. He is full-complexioned, and does not look like one with renal disease, and there is no note of this in doctor's report.

R. E.: O. D. edges somewhat hazy. Veins decidedly tortuous. Hæmorrhage along a vessel up and out near O. D. No macular change. L. E.: O. D. edges blurred. Several hæmorrhages in retina associated with white patches. Numerous small whitish spots in macular region.

Dr. Murphy of Twickenham writes, "Gen. H— died of apoplexy within a year after you saw him."

Case 4.—Mr. John A—, æt. 61, came on February 8th, 1893. Eighteen months ago he had hæmaturia, thought by his doctor to be due to passing uric acid. After the attack his urine still contained albumen, "about one fourth," sp. gr. 1015. In October, 1892, Dr. Kirkwood, of Peterborough, saw him on account of some sudden failure of vision, and found, he writes, "numerous varicose dilatations of the veins, and bright white specks in the yellow-spot region." The vision then was about $\frac{20}{200}$ in each

eye. A week or so later very extensive hæmorrhages in both eyes were noted.

On the date of his visit to me his urine contained about one eighth albumen, but no sugar. R. E. V. = $\frac{20}{100}$, L. E. = $\frac{15}{200}$; reads J. 19 with each. The arteries are bright, and show marked pressure on the veins; there are numerous hæmorrhages and white patches.

Ten months later his doctor wrote to say that the patient was seemingly very well, though his sight was evidently bad.

In August, 1895, he died of cerebral hæmorrhage.

Case 5.—Mr. Henry H—, æt. 50, came on October 23rd, 1893. The left eye was noticed to be defective about two weeks ago, but there have been occasional floating spots before it for four or five years past. R. E. V. = $\frac{20}{15}$; L. E. = $\frac{20}{100}$, not improved. In the left there are numerous retinal hæmorrhages and large white patches. The retinal arteries in both eyes are bright, and show marked pressure on the veins. No trace of albumen was found.

I have recently heard from his doctor (Mr. S. Evans of Dovercourt) that the patient "died in September, 1894, from cerebral apoplexy, a few hours after he was taken ill."

Case 6.—Miss M—, æt. 48, came on July 6th, 1894. About ten days ago there was a dimness in the right eye; at first a darkness for a minute or two, followed by great clouding. For the last week the only remnant of the attack is a dark object "something like a tadpole" towards the inner corner. V. = $\frac{20}{15}$ with each eye. The right vitreous is slightly hazy all over, with fine dust-like bodies, and one more concentrated opacity towards the outer side, evidently the one projected as described, presumably from recent hæmorrhage. The fundi were then noted as normal.

In February, 1895, she came again, and told me that in the preceding October there was a temporary recurrence

of the dimness. The field is now defective below in the left eye, and the arteries, especially the upper ones, are noted to be "silver wire" in appearance, with marked pressure on the veins. Two months later I again saw her, when there was detached retina below, and a blood-clot visible, adherent to the posterior lens capsule, near the lower periphery. The arteries were now noted as showing distinct narrowing here and there. Tay's choroiditis in the periphery of each fundus.

In May, 1895, she had a fresh hæmorrhage into the right vitreous, with vision reduced to $\frac{20}{200}$.

In February, 1898, Dr. Bramwell, of Cheltenham, writes to say that she has had an attack of hemiplegia, and is quite an invalid.

Case 7.—Mr. George G—, æt. 57, came September 16th, 1892. Three months ago, while stooping, the vision of the left eye became blurred. This passed off in a few minutes. A month ago he found that this eye was almost blind; could not see his hand before him. For some days it improved, but has remained stationary for the last ten days or so. The "blur" sometimes shifts a little and moves about. Some three or four years ago he used to have peculiar attacks of difficulty of vision, in which he saw things double. These attacks used to occur irregularly and fairly frequently, about once a fortnight he thinks, each lasting a few hours. As a young man he used to get migraine, preceded by the ordinary fortifications. R. E., Hm. 1 D., V. = $\frac{20}{15}$; L. E., V. = $\frac{10}{200}$. There are hæmorrhages in both retinæ, and also white spots of degeneration. In the right eye these are small, and to the inner side of the optic disc. In the left eye the spots are chiefly in the macular region. The arteries are very bright, and show pressure on the veins where they cross. There had been no albuminuria, but on the receipt of my letter his doctor again examined the urine and found little more than a trace of albumen, which had again disappeared on the next examination.

He returned in December, saying that a few days after his previous visit the right eye also saw patches of haze, and the sight has been bad more or less ever since. The right now gets $\frac{20}{40}$, not improved. Dr. Hewetson, of Reigate, writes to say that, a year or two previously, Mr. G— had what seemed to have been a slight paralytic stroke, but the effects quickly passed off, and there has been no return. The retina has now a hazy, œdematous look, with several white spots in the macular region of the right eye, and much pressure on a few of the veins. His doctor reports at this date, "I have examined the urine many times since, and have never found albumen again. In spite of this, though, I am afraid he has kidney disease, as his general health is unsatisfactory."

In October, 1893, Dr. Hewetson writes, "I am sorry to tell you that last week Mr. G— had a large hæmorrhage on the right side of his brain, which carried him off in about four hours. This bears out your prognosis entirely. The eyes remained in much the same state, and he went on circuit for the summer assizes, and seemed better altogether until he was seized with this fatal attack."

Case 8.—Mr. W. H. C—, æt. 55, came on June 6th, 1893. He has noticed a cloud over the sight of the right eye for the last three weeks; the upper half of an object is more dim than the lower. The left has been defective for a very long time—possibly always so.

V. $\begin{cases} \text{R. E.} = \frac{20}{200}. & \text{The letter comes and goes.} \\ \text{L. E.} = \frac{20}{100} \bar{c} \dfrac{+ 3 \text{ D. cyl. axis vert.}}{+ 0{\cdot}5 \text{ oph.}} = \frac{20}{30} & \text{well.} \end{cases}$

In the right eye the retinal veins are distended; there are numerous retinal hæmorrhages, and also several whitish spots (particularly in the macular region) probably due to changes in old hæmorrhages. The arteries are very bright, and show much pressure on the veins. In the left eye the edges of the O. D. are rather indistinct, but there is no swelling. The arteries are similar

to those in the right, and the veins are rather large ; no hæmorrhages.

Dr. Edwin Lee writes, "He has had some pricking and tingling of the fingers of the right hand. He is a gouty subject, somewhat sedentary in habit, and has considerable worry. Up to this time he has not had any renal trouble. Urine acid ; sp. gr. 1018 ; no albumen."

Three months later the vision of the right eye had improved to $\frac{20}{40}$. I did not see him again.

On inquiring lately I was answered by Mr. J. W. Applegate, who has kindly furnished me with the following notes :—"Mr. C— died on July 1st, 1895. The immediate cause of death was undoubtedly cerebral apoplexy. For the six or eight months previous to his death he had become most awkward in his gait, but this varied a good deal on different days ; for the last two months he had to be helped from one place to another. His speech at times was very indistinct, and he could make you understand nothing ; but, like his gait, this was variable. He knew what he wished to say, but could not say it. He was very irritable and passionate, and at these times had great strength. For the last month he was very drowsy during the day, but could easily be roused. His sight got worse, so that he was almost blind. The condition of his kidneys became worse, and the water contained a good deal of albumen." He suddenly became "unconscious and paralysed, with stertorous breathing, and died in six hours."

Case 9.—Mr. John M—, æt. 56, saw me in 1885 on account of epiphora. Each fundus was at that time reported normal. In June, 1896, he returned, saying that if he reads for any time his head troubles him : noises in his ears, feels giddy and stupid. Frequent headaches. R. E. V. = $\frac{20}{30}$, Hm. 1, not improved ; L. E. V. = $\frac{20}{40}$. Hm. 1·5 = $\frac{20}{15}$. Retinal arteries bright, with marked pressure on veins.

In February, 1898, he came again. Last June (1897)

he suddenly had "a fit" while sitting in his chair; he lost power of speech for half an hour or so, and had weakness of his right arm and leg. He has had no further attacks, but he easily gets excited, and then temporarily his speech gets bad. He uses the wrong word frequently in ordinary conversation. He has been very gouty for many years, and has deposits in his finger-joints. Always very temperate. Vision and fundi as before.

Case 10.—Mrs. M—, æt. 51, came to me on July 19th, 1888, complaining simply of difficulty in reading. Her distant vision was normal. No hypermetropia, and correcting glasses were ordered for close work. In November, 1890, she returned saying that two days previously she noticed "with the right eye something like a falling drop of water, and that since then there has been a veil moving over the sight of this eye." Distant vision in each eye is still perfect. The ophthalmoscope showed the optic disc healthy in each eye, and also the fundus; except I noted that the arteries were brilliant and of the "silver wire" character in both. There was a small floating opacity in the right vitreous a little in front of the optic nerve. On writing to her doctor he reported that was nothing wrong in the kidneys.

A year later she again came, complaining of a little aching in the right eye; the fundus showed no change except that near a vessel above the optic disc there were a few whitish dots (? from past hæmorrhage). Her doctor now reports that she is suffering from some peculiar symptoms of indigestion, the exact nature of which he cannot determine, and that her kidneys are normal.

In June, 1893, she returned, saying that a few days previously she noticed falling stars before the left eye, with a feeling of discomfort, but no pain. Distant vision still normal. The arteries remained brilliant in both eyes. In the right eye there are now a few bright white radiating lines near the macula, and in the left eye minute hæmorrhages. She had in the meantime changed her doctor,

and on writing her new medical attendant he reported urine rather pale, specific gravity 1015; no cloud on boiling, nor with strong nitric acid, but a slight cloud appeared after using picric acid, which formed a slight precipitate after the lapse of twenty-four hours. He made further examination with great care shortly afterwards of different samples of urine. The specific gravity varied from 1015 to 1025. One specimen gave a very slight trace of albumen, a second a still slighter trace, and a third specimen none at all. The microscope showed no casts in any of the samples. He adds, "Judging from this, I do not think that the kidneys are actually diseased at the present moment, at least we cannot diagnose from the urine kidney mischief; but judging from your examination I think it will be our duty to examine the urine from time to time, for sooner or later it may tell a different tale."

She remained in much the same condition, the retinal changes not well marked, but present in both eyes, until March, 1895. On this occasion she said that during the last three weeks she had had three or four attacks of dimness of sight, each lasting about fifteen minutes. The first was accompanied with many brilliant colours, but not the last three, in which there was "darkness." They were all followed by headache like a migraine. A recent small hæmorrhage found on the nasal side of the optic disc. Her health at this time was by no means good, and she paid occasional visits to a distinguished neurologist, who told me that he thought her symptoms suspicious of myxœdema. In February, 1896, her husband reports that her water has been examined, and was found to contain a minute quantity of albumen.

In June of 1896 she had an attack of aphasia, and saw the same neurologist again, who said it was due to embolism. In the beginning of September she had an attack of giddiness, fell down, and was unconscious for some half-hour. On regaining consciousness she could not recognise any one, and was very sick. Shortly after-

wards she paid me a visit, looking very pale and worn. The ophthalmoscopic appearances were practically as before, except that in the left eye the white patches were more numerous.

The last time she came was in December last (1897). She was looking thin, her speech was very much affected —stammering and thick,—and she was constantly using the wrong word. No ocular paralysis. Right eye $\frac{20}{30}$, left eye $\frac{20}{50}$, but can only read for a few minutes, when the words all become dim. She was seen recently at her home by a physician, who said that her kidneys were much affected, and she has been confined to bed suffering from what her doctor has called uræmia. There are fresh hæmorrhages now in both retinæ; one large one in the yellow spot in the left eye, one on the outer side of the right optic disc. She is highly emotional, shedding tears when speaking of herself. No paralysis lately.

This case is, I think, particularly important, and typical of the condition when watched from an early stage. The ophthalmoscopic appearances were definite, and easily distinguished, long before there were any other definite clinical indications of the true nature of the changes that were occurring.

Case 11.—Rev. J. M—, æt. 67, came in June, 1894.

The right eye has always been defective, and is now slightly divergent.

The left eye became dim-sighted last November, when he had a paralytic stroke. He says that it was examined by Mr. Lloyd Owen, who found "a clot of blood across the retina."

V. R. E. $= \frac{3}{200}$.
L. E. $= \frac{9}{200}$ c $\frac{+ 0{\cdot}5 \text{ cyl. horiz.}}{+ 4{\cdot}5} = \frac{20}{30}$ fairly, and with + 9 D. reads J. 1 at 6 inches.

The retinal arteries are bright, and press markedly on the veins at crossing. No hæmorrhages seen.

In March, 1898, his doctor writes, "About a year

after you saw the patient he had an attack of right hemiplegia, from which he slowly recovered, though he had aphasia for some weeks afterwards. He has quite got over that, however, with the exception of occasionally forgetting the name of a person or a word, and consequently is not able to take duty in church. Three times he has fallen down suddenly, but on these occasions he never lost consciousness, and said he suddenly seemed to lose power in his legs. Last August he had a very curious attack" (partial loss of control over movements of right arm and leg). "As regards renal symptoms, he suffers a great deal from polyuria, but I have never found either albumen or sugar. His urine has always a very low specific gravity. Mentally he is sound, though very slow in transacting business."

Case 12.—Mr. Samuel B—, æt. 50, came in August, 1894.

Last November he first noticed failure of vision; it has got gradually worse recently.

V. { R. E. = $\frac{2}{40}$ fairly; not improved.
{ L. E. = $\frac{2}{50}$ partly. Hm. 0·5 D. = $\frac{2}{40}$ fairly.

Very small colour scotoma to outer side of fixation point in L. E.; none detected in R. E.

Pupils active. Knee-jerks normal.

He smokes heavily, chiefly cigars. Denies excessive drinking, but looks like it, and there is an alcoholic odour from his breath.

There is no history of syphilis, but he has lost the right tonsil from ulceration some years ago.

Ophthalmoscopic examination.—A few fine opacities in vitreous. O. D.s are rather muddy, but not pale.

Three months later he returned. Vision is slightly worse; R. E. V. = $\frac{2}{50}$; L. E. $\frac{2}{50}$ with correction. Colour scotoma now detected in both eyes.

The O. D.s are now decidedly pale. Arteries degenerated, with marked pressure on veins.

Dr. Berry (of Charlton) writes, "Mr. B— remained

in almost the same condition until June, 1895. His eyesight did not improve, but then he would not persevere with physic, and he would neither give up tobacco nor alcohol. In June, 1895, I was summoned hurriedly to see him, and found him in a semi-comatose condition. He gradually lapsed into complete coma, with Cheyne-Stokes respiration, and died in three days. There were no paralytic signs, and there was no albuminuria. I was unable to obtain an autopsy."

Case 13.—Mrs. B—, æt. 42, came in October, 1894.

Mr. Horsley tells me that she has had repeated attacks of cerebral thrombosis, in one of which she nearly died.

About eight days previously she noticed dimness of vision in the left eye, with drooping of the upper lid. There was some pain in the eyeball.

There is paresis of the left third nerve, affecting chiefly the levator, the internal rectus, and the pupil.

L. E. V. = $\frac{20}{50}$; Hm. 3 D. = $\frac{20}{30}$ fairly. T. n.

There are remains of old vessels in both corneæ (old interstitial keratitis).

The retinal arteries in both are bright, with marked pressure on veins.

In February, 1898, Mr. Horsley kindly informs me that this patient died early in 1897, probably from progressive cerebral softening, but there was no autopsy.

Case 14.—Mr. Walter B—, æt. 43, came in September, 1895.

He says that seven days ago a steaminess came over the sight of the right eye, and remained for nearly an hour; no pain. Two days later the dimness returned, and has continued since.

R. E. pupil acts feebly to light directly. T. n. V. = $\frac{20}{200}$. There is a loss of field inwards and downwards; not complete loss here. Elsewhere the field is fairly good. (Chart taken.)

L. E. V. = $\frac{20}{30}$.

Ophthalmoscopic examination.—R. E. arteries silver wire, depressing veins. General œdema of retina, with several medium-sized hæmorrhages and a few white patches of effusion. L. E. arteries as in right. Several hæmorrhages with white patches in retina to nasal side of O. D.

A few days later Dr. F. Hinds writes, "There is a very distinct trace of albumen, but not more. The right eye continues to improve a little. I shall watch the case for hemiplegic developments."

In January, 1896, his doctor reports, "Mr. B— goes on well, and has so far recovered his sight as to be able to read."

In March, 1896, Dr. Hinds again writes, "In the last two months Mr. B— had two slight fits, one with transient paralysis. He died yesterday comatose, the attack starting with left hemiplegia. His sight had so far improved that he had been out shooting, and had shot well; he had also been able to read the paper. Always some albumen in urine."

It seemed desirable to form some idea of the frequency with which this retinal change can be detected in cases where similar arterial disease is otherwise and elsewhere indicated. With this object in view I examined all the cases of paralysis presumably due to vascular disease which happened to be present in the wards of the National Hospital on one day (February 21st, 1898). These cases were selected for me by the senior house physician (Dr. Stuart), the principle being that they were all cases of hemiplegia of sudden onset, without any suspicion of new growth, and presumably due to vascular disease. The other facts of each case were given to me *after* my examination. I have to thank my medical colleagues for permission to make these observations on their patients.

There were 17 such cases, 7 male and 10 female. Their ages varied from 25 to 71; average age 47·3 years. Of these cases 7 showed perfectly definite retinal changes

such as are described in this paper, 4 males and 3 females. The average age of these 7 cases was 59, that of the males being about one year more than that of the females. Of the 4 males, 3 had traces of albumen in the urine, with specific gravity between 1012 and 1020. The fourth had normal urine, sp. gr. 1028. The clinical diagnosis was ? thrombosis in 3 cases, and probably hæmorrhage in the remaining one. Of the 3 females there was albuminuria in one only; 2 were diagnosed as ? hæmorrhage, and the other as thrombosis.

In 3 other cases there were slight vascular retinal changes, 1 male and 2 females. Average age 46·3. There was albuminuria, but with sp. gr. 1030, in 1 (F.). In 2 the clinical diagnosis was thrombosis, in 1 hæmorrhage or thrombosis.

In the remaining 7 there were no decided retinal changes; 2 were males, 5 females. Average age 36·1.

There was albuminuria (a trace) in one only (post-partum hemiplegia) of these 7 cases. In 2 the diagnosis was thrombosis, in 1 ? syphilitic thrombosis, in 1 post-partum hemiplegia, in 2 embolic hemiplegia, in 1 no cause clinically assigned; mitral disease.

(*March 10th*, 1898.)

Postscript, June 20th, 1898.—Since the date of reading the foregoing paper four of these last-mentioned patients have died, and an autopsy was obtained in each. It will be instructive to give the notes of the ophthalmological examination (on February 21st) in each of these cases, along with the more prominent clinical symptoms, and the results of the autopsy; for these latter I am indebted to Dr. Risien Russell, pathologist to the National Hospital.

1. G—, male æt. 56. Retinal arteries markedly "silver wire;" veins depressed at crossings. No retinal hæmorrhages. Left hemiplegia, probably hæmorrhage. Urine 1028, normal. Heart normal, rather feeble now. Died March 26th, 1898. Old hæmatoma under dura mater,

adherent to it. Kidneys: capsules unduly adherent; outer layer separating, leaving inner layer on kidney.

2. C—, female æt. 38. Retinal vessels normal. Right hemiplegia. Urine 1015; no albumen. Mitral murmur. Died March 29th, 1898. Softening from old thrombosis. Kidneys large, fatty-looking; some old infarcts. Capsule easily removed without leaving rough surface.

3. P—, female æt. 52. Retinal arteries very bright, with much variation in calibre. Pressure on veins. Œdema of retina. No hæmorrhages. Tay's choroiditis over fundus generally. Right hemiplegia, ? from hæmorrhage. Urine 1020; trace of albumen. Heart normal. Died May 23rd, 1898. Large hæmorrhage in right hemisphere; old yellow softening in left hemisphere. Atheroma of cerebral vessels. Kidneys small, markedly contracted, granular. Cortex reduced. Markedly granular surface on removing capsules, which were very adherent.

4. T—, male aged 66. Retinal arteries "silver wire." Veins depressed at crossings. No hæmorrhages. Left hemiplegia, ? thrombosis. Urine 1018; trace of albumen. Heart normal. Died June 1st, 1898. Small patch of yellow softening in internal capsule and adjacent part of optic thalamus. Kidneys contracted, granular. Capsules adherent, and leave granular surface on being removed. Cortex considerably reduced.

It will be noticed that three of the four deceased patients had marked retinal arterial changes, and these three had also granular kidneys. During life the urine was normal in one of these, and contained only "a trace" of albumen in the other two. Two had intra-cranial hæmorrhage; the other showed signs of old thrombosis. The mortality among the seven cases of hemiplegia noted as having retinal arterial disease, in a little over three months, has therefore been very striking (nearly 43 per cent.).

In the fourth case of death the retinal vessels had been noted as normal, and the kidneys were found to be free from granular change.

The PRESIDENT thought they should thank Mr. Gunn for his brilliant paper on an exceedingly important subject, which he had worked out in a most careful way. Every study which tended to bring their special branch to bear upon general medicine was of intense interest, and there was hardly any of these subjects of deeper interest than that which Mr. Gunn had so carefully investigated.

Mr. BRONNER asked whether some cases of so-called retro-bulbar neuritis were not simply cases of disease of retinal arteries. They could get contracted fields and partial loss of vision caused by changes in the retina due to local disease of the arteries.

Dr. JAMES TAYLOR said he would like to express to Mr. Gunn his appreciation, which he felt sure most physicians would share, of the extreme value of his paper. He (Dr. Taylor) had been fortunate in being associated with Mr. Gunn in seeing several of these cases. Unfortunately, in many of them cerebral mischief had already occurred. He thought it of the very greatest importance that the matter should be brought before not only ophthalmic surgeons, but also before physicians, so that they might be able to recognise what was, in many cases, a premonitory condition to the severe forms of paralysis with which they were called upon to deal later. He thought the condition was not difficult to recognise ophthalmoscopically. In the out-patient room at Queen Square he had seen many cases which he had referred to Mr. Gunn, which he suspected to be of the nature that he had described, and in most of the instances Mr. Gunn's opinion had coincided with his own. He thought the paper was of very great interest, and of the utmost importance.

Dr. ALDREN TURNER said that his attention had been

directed to this condition when he was a pupil of Mr. Gunn at Moorfields. He desired to ask two questions from the point of view of prognosis:—First, whether Mr. Gunn could state how long the vascular changes existed before the onset of albuminuria; and secondly, what period might elapse between the detection of the arterial degeneration and the onset of cerebral hæmorrhage.

Mr. Marcus Gunn, in reply to Mr. Mackinlay, said that, as to the prognosis from the point of view of albuminuria, one peculiarity of these cases was that there might never be albuminuria, and they confirmed in that respect the experiences recorded by Gull and Sutton many years ago, namely, that there was an arterial sclerosis affecting certain parts of the body, but not necessarily so affecting the kidneys as to cause albumen to appear in the urine. He did not think it was possible to say when they might have albumen in the urine; possibly it might not appear at all. He thought the urine should certainly be examined from time to time in patients in whom they might suspect it from the condition he had described. It was difficult to speak of the prognosis as to cerebral hæmorrhage, but he would say that it was only in cases where the retinal changes had so far advanced as already to have caused hæmorrhages in the retina that one could speak of the probability of an approaching cerebral hæmorrhage. Sometimes one symptom might be very much in advance of the other, but where we saw these advanced changes in the retina we would certainly have a reason for giving a grave prognosis as to the near probability of hemiplegia or other evidence of cerebral hæmorrhage.

In answer to Mr. Bronner, he did not think there was any great difficulty about the differential diagnosis between retro-ocular neuritis and affections in the arteries of the retina only. He thought if they had an affection of an artery in the retina only, grave enough to cause loss of vision, they would, in all probability, get œdema, at any rate over the area supplied by that artery, and very

likely more gross changes which they could see, and probably hæmorrhages. But the distinction between an affection of the branch of the arteria centralis going to the axis of the nerve near the disc, and retro-ocular neuritis, was a very difficult one to draw.

7. *Ophthalmoplegia externa with bulbar symptoms and marked weakness of orbicularis palpebrarum on each side.*

By James Taylor.

Diplopia two years ago, drooping of lids one year ago; six months ago weakness of left arm, and now difficulty in articulation, with occasional regurgitation of fluids and difficulty in swallowing, ptosis, and interference with all ocular movements.

The case is shown on account of the very marked weakness of the orbicularis palpebrarum associated with ophthalmoplegia, but without facial paralysis. The association of weakness of the orbicularis with ophthalmoplegia was pointed out by Dr. Hughlings Jackson a few years ago. Mendel had previously directed attention to the possible innervation of the orbicularis from the third nucleus, and Tooth and Turner had published a case in which the pathological condition had seemed to indicate this. The presumption is that the ultimate innervation of the orbicularis palpebrarum is from the third nucleus, as that of the orbicularis oris is probably from the hypoglossal.

(*Card specimen. May 5th,* 1898.)

The President said it was an extremely interesting case. He thought Dr. Hughlings Jackson held that the orbicularis was more frequently affected than was gene-

rally imagined; often the affection might be very slight and therefore easily overlooked.

Dr. Beevor thought the case a very important one. A year or two ago he showed before the Society a case of paralysis of all the ocular muscles, and in that also there was double ptosis and weakness of the orbicularis palpebrarum, so much so that when the eyes were tightly closed the lids could be lifted up with the greatest ease with the little finger. Therefore he thought that in all those cases where the nucleus was involved, and in which there was ophthalmoplegia externa, the orbicularis palpebrarum was also affected. Another interesting point in his own case was that the patient was quite unaware of anything being amiss beyond the fact that the eyelids drooped; she had no idea that she had fixation of the muscles of the eyes. In fact, she came to the hospital as a friend with her father, who had hemiplegia, and he (Dr. Beevor) thought she was the patient. She was in the habit of moving her head instead of her eyes. Therefore the condition might often be overlooked by the patients themselves.

The case of Dr. Taylor's was of special importance because, as he understood, the muscles which were supplied by the other nuclei of the bulb were somewhat affected. She had some affection of the soft palate, and also of the arm, and, as far as he knew, it was very rare indeed to get in ophthalmoplegia externa the disease extending to the other muscles supplied by the other nuclei of the bulb. They knew that in bulbar paralysis there was wasting of the muscles of the tongue, larynx, and soft palate, the muscles of the eyeball escaping; but in this case the disease began in the muscles of the eyeball, and afterwards affected the muscles supplied by the other nuclei of the bulb.

Mr. Flemming asked whether it was possible to try the electrical reactions of the orbicularis; there should be some alteration in reaction if the muscle were innervated from the third nerve nucleus. He thought anatomists

were now agreed that such was the real nerve-supply of the muscle.

8. *A case of iodoform amblyopia.*

By Anderson Critchett.

A lady, Miss E. J—, æt. 64, consulted me last March for failure of sight. She told me that about a month previous to her visit she was doing her hair in front of the looking-glass when she noticed that she could hardly see her face. A mist seemed to come quite suddenly before her; she thought that both eyes were simultaneously affected.

Her vision I found to be very bad indeed:

R. V. $< \frac{6}{60}$ Sn., J. 20 $\bar{c}$ $\frac{+ 4 \text{ D. sph.}}{+ 1 \text{ D. cyl. a. h.}}$ not improved;

$\bar{c}$ $\frac{+ 8 \text{ D. sph.}}{+ 1 \text{ D. cyl. a. h.}}$ = J. 16.

L. V. $< \frac{6}{60}$ Sn., J. 19; $\bar{c}$ + 1 D. sph. not improved;

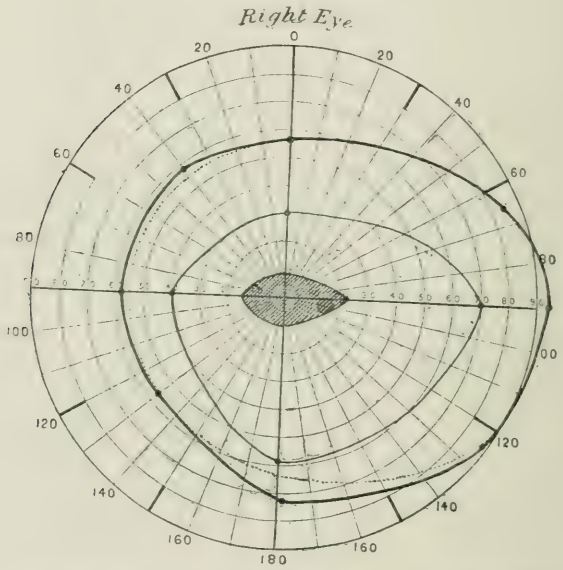
$\bar{c}$ + 5 D. sph. = J. 16.

The media were clear and both fundi normal with these exceptions, that to the inner side of each macula was seen a small yellow granular deposit, and the outer half of each disc was slightly paler than the inner half, but not completely devoid of colour. The disc margins were not blurred.

The visual field for white was perfect centrally and peripherally, somewhat dirty white at the centre, but she could tell it was white. The colour sense was much impaired. The only colour she could distinguish was blue; she called pink blue, and could not distinguish any difference between red and green. Her loss in colour sense did not conform to any regular type of congenital colour-

blindness; besides, her power to distinguish colours, she states, corroborated by her sister, used to be excellent. She had a definite scotoma for blue in her R. E., but only recognised this colour over a very limited area in her L. E. (see charts).

Fig. 31.



Visual fields for white and blue, with a large central scotoma for blue. (March 21st.)

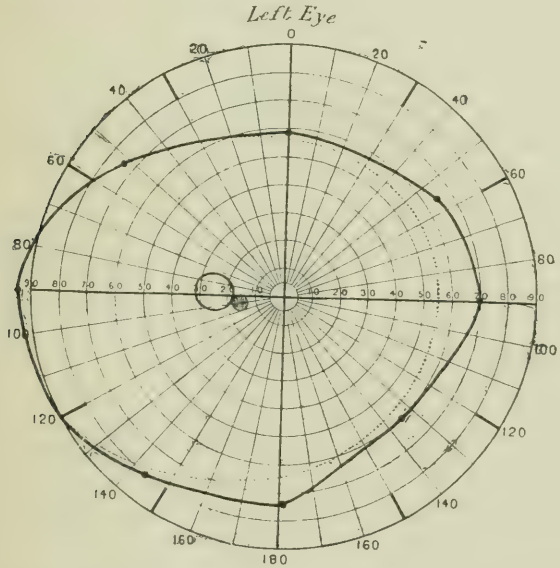
Inquiring into her past history, I discovered that fifteen years ago she had a tumour excised from her right breast; she thinks that the whole breast was removed, but she was never told the nature of the tumour. Four years ago it recurred. It is now a wide-spread cancerous ulceration with much discharge; at times it bleeds freely. She has for the last three years been in the habit of applying iodoform liberally to it without intermission, and in much greater quantities during the last twelve months, using sometimes more than an ounce in a week.

She has never been addicted to smoking, has always been temperate, and has only taken tonics (no special medicines or quack remedies). There is no reason to suspect syphilis.

The tumour, a scirrhus, has extended beyond the limits of operative interference.

I have seen the patient twice since I stopped the application of iodoform (March 21st), and noticed improvement in vision at each visit.

FIG. 32.



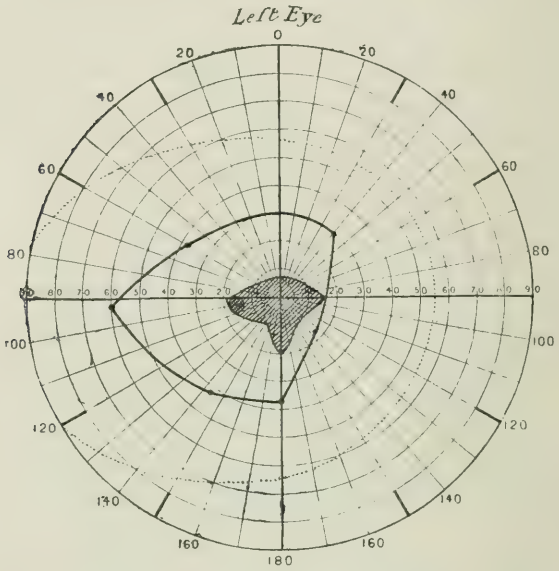
Visual fields for white and blue, the latter being very contracted. No other colour recognised. (March 21st.)

Her vision is still less than $\frac{6}{60}$ Sn.; she sees $\frac{4}{60}$ Sn. and J. 14 with correction, and with each eye separately.

There is marked improvement in her colour sense. She can now pick out all the greens without including any of the confusion colours. Though in some parts of her visual field she can see green, at present it cannot be mapped out. She can see red, and has a definite scotoma

for that colour as well as for yellow and blue (see V. F. for red). Gold and silver coins are difficult of distinction.

FIG. 33.



Visual field for red, with large central scotoma. (June 7th.)

Beyond her eyes the iodoform does not appear to have given rise to any other trouble; no diarrhœa, no drowsiness or hebetude, no headache, &c. Her urine is normal.

Remarks.—Though many cases of iodoform poisoning, acute and chronic, have been published, the literature of iodoform amblyopia is scanty. Treves, writing on the subject of iodoform poisoning in 1886, makes no reference to amblyopia. Cases of toxic amblyopia attributed to iodoform have been recorded by Hirschberg, Hutchinson of America, Priestley Smith, Valude, and Terson. The essential features in these cases appear to be a central colour scotoma, partial pallor of the optic disc, and more or less sudden and considerable impairment of vision; in other words, signs of retro-bulbar neuritis.

In spite of the serious visual defect in this case I have been unable to discover an absolute scotoma as Mr. Priestley Smith did in his case. The most interesting point in the case is, perhaps, the extreme loss of colour vision—almost complete. In Valude's case it was complete, whereas in Terson's case the colour scotoma was only relative, not absolute, *for colours*, as in this case and in that of Mr. Priestley Smith. The scotoma is much larger than that seen in tobacco amblyopia.

Whether the granular changes seen to the inner side of each macula lutea are of any significance the report of subsequent cases may possibly reveal; they have not been noted by the other observers, yet it is of interest that similar changes have been recorded in connection with tobacco amblyopia.

(*Card specimen. June 9th*, 1898.)

Dr. Argyll Robertson said there was only one point which militated against the idea that the choroidal change had to do with the scotoma, viz. that the colour perception that remained was in the centre of the field of vision; it was not peripheral. The perception of blue was only centrally situated, which was rather against the idea that the central lesion of the choroid had much to do with the imperfect sight.

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9. *Subconjunctival bloodletting for hæmorrhagic retinitis.*

By F. R. Cross.

Bloodletting as a therapeutic agent is probably not very frequently resorted to in the present day by general surgeons, although there can be little doubt as to its value in many inflammatory conditions, such as pleurisy, pericarditis, and orchitis. In ophthalmic practice, however, it has always maintained its position, and there are few oculists who would deny the efficacy of leeching the lids

or temple in cases of iritis or irido-cyclitis; while many strongly approve of the abstraction of blood from behind the ear, for the relief of congestions of the choroid or of the retina.

Feeling quite convinced of the value of such treatment, and recognising that a considerable amount of blood escapes from the wounded vessels in an operation for squint or similar subconjunctival interference (while I do not remember to have ever seen any awkward symptoms or excessive bleeding resulting from such treatment), I determined to try what effect would be produced upon intra-ocular hæmorrhages or congestions by a more or less free division of the blood-vessels running along the muscles, or in the connective tissue of the orbit surrounding the eyeball.

My method of operating consists in making subconjunctival openings between the recti, and cutting with straight or curved scissors any vessels which happen to lie between the muscles and the eyeball. I usually make my incisions between the inferior and internal recti, as in the usual operation for convergent strabismus, and between the superior and external recti. In operating down and out there is perhaps some danger of cutting the inferior oblique; while in the superior and internal quadrant of the eye the superior oblique might be exposed to a similar but greater risk.

I have had no reason to regret my interference in any of my cases, as no harm of any kind has resulted; while n several of them there has been sufficient improvement to justify me in recommending this plan of abstracting blood from branches of the ophthalmic artery, as near as practicable to those which supply the retina and choroid.

A few illustrative cases follow.

Case 1.—Walter B—, æt. 60, first attended at the Bristol Eye Hospital on December 22nd, 1896, complaining of dimness of vision in the right eye. He said that for about three weeks previously he had noticed a

slight mistiness of vision as if he needed stronger glasses, and for the four days immediately preceding his visit he had been troubled with a cloud in front of his right eye.

The patient's general condition was good. He had a stiff knee-joint which followed inflammation many years ago. The cardiac sounds at the apex were not quite clear, but there was no distinct murmur. There was no increased arterial tension, nor abnormal pigmentation of skin, and the urine was normal.

Ophthalmoscopic examination showed in the right eye numerous hæmorrhages around the disc, chiefly in the striate layer of the retina; some optic neuritis, and much congestion of the retinal vessels. V. = $\frac{6}{12}$, J. 16; no improvement with lenses for distance or reading. In the left eye there was a suspicion of neuro-retinitis. The vision was normal.

The patient was admitted to hospital, had two leeches to his right temple, and was treated with iron and arsenic for twenty-four days, at the end of which time his right optic nerve was much swollen, the hæmorrhages were more marked, and the vision had diminished to $\frac{6}{60}$.

On January 14th incisions were made through the conjunctiva in four places with strabismus scissors, which were pushed backwards and moved about in the orbital tissues, so as to lacerate as many blood-vessels as possible. The eye was fomented with warm sponges for an hour afterwards.

Next morning the nerve was distinctly less swollen, while the pupil, which had previously been small, was dilated.

On the fifth day after the operation the vision of the right eye was $\frac{6}{24}$.

On the seventh day after the operation the pupil was again contracted and normal, while the condition of the fundus was definitely improved.

A month after the operation the hæmorrhages were much less, but there were still some fine ones in the retina, especially along the inferior temporal vein, which

was over-distended, and appeared to have ruptured. The vision was $\frac{6}{12}$. Iron and arsenic were prescribed.

One year after operation the patient attended with the right fundus quite clear, and the vision of the right eye $\frac{6}{6}$. There were some fresh hæmorrhages in the left fundus.

Two months later there was a silvery star in the macula lutea of the left eye, and a few hæmorrhages in the fundus. The right eye was still clear. There was no albumen in the urine throughout; it was repeatedly examined, and always found normal.

On June 13th, 1898, the patient's eyes were quite well; he had a vision of $\frac{6}{6}$ in each, and is following his usual occupation as a clerk.

Case 2.—Charles G—, æt. 42, attended at the Bristol Eye Hospital on November 2nd, 1897, complaining that for the previous three and a half years the vision of the left eye had been very misty, and that the sight of the right eye had suddenly failed during the summer of 1896, so that he could not read print smaller than J. 14. For two months after this his sight got gradually worse, so that at the end of that time, according to his medical attendant, he could only see light. He was treated with iodide of potassium, and said he thought his vision was slightly better than it had been.

The general condition of the patient was good; his urine, heart, and vessels were normal; he had no varicose veins or varicocele. There was no history of syphilis, and he had no relatives with disease of the eyes or bad sight.

Ophthalmoscopic examination showed in the right eye retinitis with exudation, and hyperæmic patches with varicose vessels, and fibrous thickening on some of the arterial coats and other parts of the retina. There was a large hæmorrhage just above and in the outer part of the disc; the macula was atrophied, and there were some shining lymph spots around the disc. The vision of the eye was $\frac{1}{60}$, J. 20, and was not improved by any lens. The field was full, and colour vision good. In the left

eye there was macular atrophy with evidences of old hæmorrhages on the disc; there was a varicose mass between the superior and inferior temporal veins. The vision was $\frac{6}{24}$, J. 16, and was not improved by lenses. The field was full, but colour vision defective.

The patient was treated for nine days with Liq. Arsenicalis and rest in hospital, and as there was no improvement at the end of that time an operation similar to that described in the last case was performed on November 11th, 1897.

Next morning the lids were slightly œdematous, the pupil was contracted, and the fundus was pale.

Four days after the operation the retinal vessels were still small, and the hæmorrhage on the disc had diminished in size.

On November 17th the patient had two leeches behind his left ear.

On November 25th the hæmorrhages in the right eye were distinctly less, the optic disc was clearer, and the lymph spots were less marked.

On January 25th, 1898, the vision of the right eye was $\frac{2}{60}$, J. 16, and that of the left was $\frac{6}{18}$, J. 10. There was no improvement with lenses in either eye.

Case 3.—Eliza C—, æt. 54, had been attending the Bristol Eye Hospital as an out-patient at intervals for the past three years, complaining of defective vision in the left eye.

Her general condition was good, and urine normal.

When first seen the patient had peripheral striæ in each lens, and the upper part of the left optic disc was slightly cupped. She was treated with eserine drops, and had spectacles ordered to correct her error of refraction. Between the time of her first attendance and January, 1898, the vision of the patient's right eye with glasses varied between $\frac{6}{12}$ and $\frac{6}{6}$, while that of the left, also with glasses, varied between $\frac{6}{18}$ and $\frac{6}{9}$.

On January 13th, 1898, the patient came complaining that she could not see to thread a needle. On testing

her sight the vision of the left eye with glasses was found to be $\frac{5}{60}$ only, and on ophthalmoscopic examination a small subretinal hæmorrhage was seen in it just above the disc. Four days later the hæmorrhage had very much increased, the retina above the disc was much swollen or pushed forwards, and had the appearance of a wide curtain hanging down and folded back over the edge of the disc.

On January 25th there was no alteration in the appearance of the fundus, and an operation similar to that described in the first case was performed.

On January 31st there was much less hæmorrhage at the upper edge of the disc.

On February 3rd the hæmorrhage above the disc was much thinner, and almost on the same level as the fundus instead of bulging towards the vitreous, as it had done previously.

On March 8th the peculiar overhanging appearance at the upper edge of the disc had quite disappeared, but there was still much hæmorrhagic retinitis. The vision with correction was $\frac{6}{36}$.

On June 29th the vision was still $\frac{6}{36}$, but the condition of the fundus was much improved. The retina was free of swelling, but there were a few reddish hæmorrhages and several brownish patches where the hæmorrhages were undergoing absorption.

Case 4.—Emma C—, æt. 68, attended at the Bristol Royal Infirmary on March 21st, 1898, complaining of dimness of sight in both eyes. She said that up till three months previously she had been able to work with glasses, but after a bad attack of bronchitis which confined her to bed for two weeks she found she was unable to work or read.

With regard to her general condition her heart was hypertrophied, but there was no murmur heard; her arteries were hard and tortuous, and her urine contained a trace of albumen but no sugar.

Ophthalmoscopic examination showed neuro-retinitis in the right eye, while in the left the optic nerve was atrophic.

The vision of the right eye was $\frac{1}{60}$, J. 20. There was no improvement with lenses. The field for hand movement was good.

The vision of the left eye was $\frac{1}{60}$, J. 20. There was no improvement with lenses, and the field for hand motion was good to their inner side and centrally, but faulty elsewhere. Both pupils were active.

On March 25th the patient was admitted to the Infirmary, and had a leech applied to the external canthus of her right eye.

On April 4th the retinitis in the right eye had assumed a well-marked hæmorrhagic character, the fundus being filled with radiating hæmorrhages.

On April 18th the hæmorrhages were browner, and the condition of the fundus appeared to be improving.

On April 22nd an operation similar to those on the other patients was performed. The vision on this date was $\frac{1}{36}$.

On April 29th the fundus looked clearer, and the patient thought her sight clearer.

On May 2nd the nerve was clearer, but there was still much hæmorrhage, and the vision remained unaltered.

There need, I think, be no anxiety as to dangerous hæmorrhage occurring into Tenon's fascia. I have never known such an accident to follow any subconjunctival operation, and the following is the most definite case of such intra-orbital hæmorrhage which I can remember to have seen.

On September 1st, 1892, my friend Mr. Dacre of Clifton was sent for, to see Margaret S—, æt. 6. The child had very marked complete subconjunctival hæmorrhage on the right eye in all directions. No pale sclera could be seen. The eyeball was scarcely if at all prominent, the movements were normal, the sight was good,

and there was neither pain nor pulsation. There was a very indefinite history that the child may have struck her eye or orbit against a drawer three days before, but she made no complaint at the time, nor was there any bruise. On the evening of the same day the hæmorrhage had considerably increased, and there was definite proptosis, and on the next day both symptoms were still more marked; the conjunctiva seemed threatening to burst; the child was merely fretful.

During the next few days the proptosis was fully maintained, but the subconjunctival hæmorrhage was somewhat absorbing.

On September 9th I saw the child in consultation. The right eye was much proptosed, apparently by a hæmorrhage which still stained the conjunctiva and the skin of the lids, particularly the lower one. The movements of the eye were impaired, but the pupil, tension, vision, and fundus were all good.

On September 16th no blood could be seen, but the eyeball was perhaps rather more prominent.

On October 19th the proptosis continued as before, and the fundus was noticed to be abnormal. The optic disc was cloudy, the central vein very full, with a few hæmorrhages as if it were thrombosed, and I confirmed this opinion in consultation.

As the progress of the case was so slow, the child was sent a few days later to Mr. Jonathan Hutchinson, who agreed with us as to the orbital hæmorrhage and resulting clot, and as to the implication of the optic nerve, and recommended Liq. Hyd. Perchl. ʒj three times daily.

On January 1st, 1893, Mr. Dacre reported that the patient had continued to take the medicine regularly, the proptosis had practically disappeared, the edge of the disc was distinct, and the vision was normal.

(*July 8th,* 1898.)

The PRESIDENT said they must all be obliged to Mr. Cross for suggesting any new method for the absorption

of retinal hæmorrhage, for such cases were amongst the most troublesome they had to deal with. He would not fear to perform the operation on account of the danger of hæmorrhage into the capsule of Tenon. He had several times seen hæmorrhage into that capsule, but never with any serious results.

---

10. *A note on conjugate movements of the eyeballs.*

By William Aldren Turner, M.D.

It is a point on which there is still some difference of opinion, whether the sixth nerve nucleus should be alone regarded as the lower or pontine centre for conjugate movement of the eyeballs; whether the fibres which pass from this nucleus by way of the posterior longitudinal bundles directly enter the roots of the third cranial nerve, or are intercepted in a group of cells in the third nucleus; and how and by what route the cortical efferent fibres reach the nucleus of the sixth nerve.

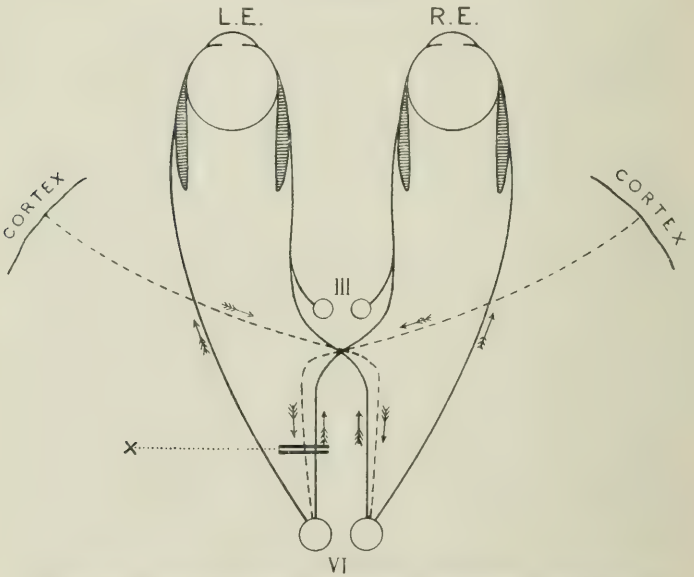
On the second point the evidence is conflicting, but in a case recently recorded by Drs. Gee and Tooth ('Brain,' vol. xxi, p. 1) of hæmorrhage involving the tegment of the pons and adjacent structures, degenerated fibres were observed in the roots of the third cranial nerve, which fibres appeared to have come from the destroyed sixth nucleus by way of the posterior longitudinal bundles.

Should this observation be confirmed, it would point to a direct innervation of the internal rectus muscle from the sixth nucleus, so far as its action in conjugate movement is concerned. That a double innervation for the internal rectus exists is shown by the fact that paralysis of convergence may occur independently of paralysis of conjugate movement, and *vice versâ*.

As regards the first point, there is accumulating evidence that a lesion limited to the tegmentum pontis,

involving the nucleus of the sixth nerve, occasions loss of the conjugate movement of the eyeballs towards the side of the lesion. Such an instance is the well-known case of Bennett and Savill ('Brain,' 1889), in which a patch of softening limited to the nucleus of one sixth nerve caused paralysis of the conjugate movement towards the same side.

FIG. 34.



Schema of the mechanism of conjugate movements of the eyeballs.

X. Lesion of the tegmentum pontis. III. Portion of third nerve nucleus subserving convergence of the globes. VI. The sixth nerve nucleus. The dotted line represents the cortico-pontine tract.

My object in this communication is to submit the result of an experiment* performed upon a monkey, in which, as a sequence of left-sided destruction of the tegmentum pontis and the adjacent part of the posterior longitudinal bundle, excluding the nucleus of the sixth nerve, *persistent conjugate deviation of both eyes to the right side, and inability to turn them to the left,* was obtained.

* Ferrier and Turner, 'Phil. Trans.,' vol. cxc, pp. 1—44, exp. 22.

This condition remained without alteration during the six days of life after the operation.

In attempting to find an explanation of these phenomena, it should be borne in mind that there are in the central nervous axis two segments in the mechanism of conjugate movement; one a cortico-pontine from the cerebral cortex to the nucleus of the sixth nerve, the other segment being between the sixth nucleus of one side and the third nucleus or nerve of the opposite side. Should the cortico-pontine fibres, for example, be divided on the right side, as occurs from hæmorrhage into the internal capsule, the eyes are conjugately deviated towards that side. The patient, it has been said, "looks to the lesion," from the unopposed action of the left centres.

In the experiment under consideration a lesion was artificially produced in the tegment of the pons on the left side (x), with the result that the eyes were conjugately deviated towards the right, just as in the case of a lesion of the right internal capsule.

The hypothesis is therefore advanced that the cortico-pontine fibres subserving conjugate movement of the globes decussate in the neighbourhood of the quadrigeminal bodies, and pass to the sixth nerve nuclei in the tegment of the pons Varolii. This receives support from the fact that the pyramidal system was unaffected; but whether the fibres pass in the posterior longitudinal bundles or in the adjacent tegment cannot be decided from this experiment, as both these structures were necessarily destroyed.

In contra-distinction to this marked and persistent conjugate deviation of the eyes away from the lesion, with palsy of conjugate movements towards the side of lesion as a result of injury to the tegment, may be placed the results of removal of the upper or cortical centres (so called) for ocular movements.

As is well known, removal of the frontal lobe is not followed by any ocular paralysis beyond a temporary inability to move the eyes conjugately to the side opposite

the lesion; and as destruction of the angular gyrus is entirely negative in this respect, an experiment was performed so as to remove both the frontal lobes and the angular gyri. These were destroyed first on the left side, and after a few days on the right side.*

The effect of the first operation was to cause temporary conjugate deviation of both eyes towards the side of lesion (left), with temporary paralysis of the conjugate movement to the opposite side.

On subsequent removal of the right frontal lobe and angular gyrus the eyes were deviated towards the right, but there was no ptosis, nor were the opening and closing movements of the lids in any way affected. The facts *quâ* ocular movements as ascertained from this experiment indicate (1) that both frontal lobes may be removed without any impairment in the movements of the eyeballs other than a temporary inability to turn them to the side away from the lesion; and (2) that in addition to the frontal lobes the angular gyri may be removed without any further impairment in the movements of the eyes or of the eyelids.

From this it may be argued that ophthalmoplegia, in its proper sense of impairment in the movements of the eyeballs in all directions, does not result from purely cerebral lesions; and that paralysis of the conjugate movement of the globes of more than a temporary nature results from a destructive lesion of the tegmentum pontis, with or without involvement of the nucleus of the sixth nerve.

(*July 8th,* 1898.)

The President said it was an exceedingly interesting paper on an abstruse and interesting question. Some years ago Pick, of Prague, devised a scheme founded upon certain experiments and pathological investigations, in which he advanced the view that there was a special nuclear centre for convergence contained in a group of

* Op. cit., exp. 8.

cells in front of the other oculo-motor cells, and in the middle line, which he took to be the centre for convergence. It seemed a plausible theory, but he understood that Dr. Turner did not adopt it. He would like to hear whether Dr. Turner had come across that nucleus in his investigations.

Dr. Turner, in reply, said he had never seen a case in which the power of convergence was congenitally absent, but he had seen one of paralysis of convergence. In the sketch which he had put upon the board he depicted the centre for convergence, giving rise to certain fibres of the third nerve which supplied the internal recti muscles. So that if it were true that paralysis of convergence might occur without any other palsy of ocular movements, he thought it was a point in favour of a special nucleus for convergence. When paralysis of convergence occurred there was associated loss of pupillary contraction on attempts at convergence, although the pupillary light-reflex was retained. This was the converse of the Argyll-Robertson symptom. That seemed to him to point to a double centre for pupillary contraction; one subserving the light-reflex, the other pupillary contraction or convergence.

---

11. *Chancre of lacrymal sac.*

By Simeon Snell.

On April 14th, 1898, I was consulted by Mr. A—, a young medical practitioner, on account of what he deemed was inflammation of the lacrymal sac on the left side.

He stated that about March 26th he had first noticed something wrong with the eye, and at that time there was some irritation along the eyelids. Boracic lotion afforded relief.

A swelling appeared over the lacrymal sac on April 3rd, and gradually increased in size until his coming to

me. At about this time epiphora was first noticed. The swelling had not been painful except when pressed hard. He stated also that pressure over the sac occasioned regurgitation of muco-pus. Shortly after the swelling over the sac was noticed the glands in the neck under the lower jaw became enlarged.

When seen by me on April 14th there was considerable swelling of the lacrymal sac. There was no abrasion of the surface or ulceration of any other part of the eyelids. The swelling was more confined to the immediate region of the sac, and the edges were more defined and the skin less involved than is usual in ordinary cases of inflammation of the lacrymal sac. Pressure occasioned some pain, but did not materially lessen the size of the swelling. There was marked epiphora. The cervical glands were somewhat enlarged and hard, but there was very little induration of the pre-auricular gland. The view taken at first was that it was a subacute inflammation of the sac. A boracic lotion was ordered, and he saw me two or three times subsequently.

On April 25th the appearance had not materially altered, but the hardness and the well-defined margins of the tumour were particularly noticeable, and suggested the possibility of a neoplasm. The patient was questioned, but denied syphilis. The lower canaliculus was thereupon slit up, and the nasal duct probed; little or no escape of pus resulted. The divided edges were brawny-looking. Probes were passed on two subsequent occasions, and some diminution of the hardness and size of the swelling followed.

On May 13th, after an absence of a week, he called again, and stated that a rash had appeared on his chest and back on the 11th, and that both tonsils had become ulcerated a few days earlier. Now there was a typical macular syphilide on chest and arms, and superficial ulceration of tonsils. There was considerable enlargement of the cervical glands at the angle of the jaw.

He was at this time placed under the influence of

mercury (Hyd. c̄ Cret. with Dover's powder), and the swelling and surrounding induration of the lachrymal sac quickly dispersed, together with subsidence of the "secondaries."

This case I take to be one of primary chancre of the lachrymal sac. If not unique, a primary sore in such a situation must be of the greatest rarity. A search through the literature at my disposal, including Bulkley's classical work on "Syphilis in the Innocent," * has not disclosed a similar instance to the one recorded. It is, however, of course well known that syphilis in its later stages is associated not infrequently with lachrymal disease.

The present case presented some difficulty, especially at the outset. Though differing somewhat from the usual run of cases of subacute inflammation of the sac, there was nothing either in the appearance or the induration to suggest a chancre. Later, when the well-defined tumour reached along the inner orbital wall, the question of a neoplasm or gumma arose. With this latter aspect in view he was questioned as to syphilis. He positively denied having acquired it, and a subsequent penile examination confirmed his assertion. The appearance of the skin affection and ulceration of the tonsils, however, occurring as they did in correct sequence as to time if the initial lesion had been in the lachrymal sac, seemed very conclusively to point to the induration in the sac as having been in reality a chancre. The subsequent dispersion of the tumour under mercurials confirmed this view of the case.

The manner in which the virus was conveyed into the sac is not clear. My patient had, it is true, several syphilitic cases under treatment, and it is possible that the virus was conveyed from his fingers to the surface of the

* My friend Dr. Burgess has kindly looked in Neumann's 'Syphilis,' published in 1896, and finds there is no mention of a primary chancre of the lachrymal sac, either in the section, "Die syphilitischen Augenkrankheiten," written by Dr. Klein, or in the rest of the work.

globe, and thence passing into the sac had been absorbed and occasioned the chancre, just in the same way as an intra-urethral chancre would be caused.

The entire absence of ulceration of the surface, the chancre being confined inside the sac, was misleading in this case. Another point to be noticed was the absence of induration of the pre-auricular gland, so prominent a characteristic of primary syphilitic lesions of the eyelids. This was no doubt due, as Mr. Connell, house surgeon to the Royal Infirmary, pointed out to me, to the fact that the lymphatics of the sac drain to the cervical glands at the angle of the jaw, and these were implicated in the case just related.

(*July 8th*, 1898.)

APPENDIX.

The following card specimens were also brought before the Society during the session.

Odell and Porter's centring instrument for ophthalmic lenses.

W. Adams Frost (October 21st, 1897).

Ruptured choroid and (?) central hæmorrhage.

Rayner D. Batten (October 21st, 1897).

Recent embolism of central retinal artery.

Norman M. Maclehose (November 11th, 1897).

A brief note upon a curious appearance of the cornea, apparently caused by a local deposition of permanganate of potash.

Sydney Stephenson (November 11th, 1897).

Sarcoma of orbit removed by operation.

A. Stanford Morton (December 9th, 1897).

Pseudo-glioma, museum specimen.

C. Devereux Marshall (December 9th, 1897).

Perforating wound of right globe.

W. A. Brailey and J. W. H. Eyre (December 9th, 1897).

Foreign body lodged in fundus.

G. Hartridge (January 27th, 1898).

Rupture of choroid with extensive retinal pigmentation, the result of severe concussion of the eyeball.

G. Hartridge (January 27th, 1898).

Congenital polycoria.

G. H. Hogg (May 5th, 1898).

? Exudation around an opaque membrane in pupil.

R. M. Gunn (May 5th, 1898).

Large black hairy mole of face, including lids of right side.

Ernest Clarke (July 8th, 1898).

Inflammatory mass in vitreous.

W. Adams Frost (July 8th, 1898).

Diseased retinal artery in arterio-sclerosis.

R. Marcus Gunn (July 8th, 1898).

REPORT OF COUNCIL,

Read at the Annual Meeting of the Society, July 8th, 1898.

The Council records with pleasure the continued prosperity of the Society during its past session. Four members have resigned, two have died, and fifteen new members have been added to the roll. The meetings have been well attended, and the clinical evenings seem to prove an agreeable and useful variation from the ordinary meetings.

The Bowman Lecturer for the year was Mr. Priestley Smith of Birmingham, and his able and lucid address will still be fresh in the recollection of the members of the Society.

The Council has received the Report of the Committee on Enucleation, appointed in March, 1896, and it is now laid before the Society.

The Treasurer's report and balance-sheet are already in the hands of members, and show that the financial condition of the Society is satisfactory.

The Council is desirous of recording its appreciation of the valuable services rendered to the Society by Mr. Cowell, who now retires from the office of Treasurer, after having held the post for the long period of seven years.

ACCOUNT OF RECEIPTS AND PAYMENTS (1897–8)
OF THE
OPHTHALMOLOGICAL SOCIETY OF THE UNITED KINGDOM.

Receipts.

1897–8.	£	s.	d.
To Balance at Bankers, June 18th, 1897	77	8	6
,, Subscriptions, 1895–7 (17) £17 17 3			
,, 1897–8 (240) 252 0 0			
,, 1898–9 (4) 4 4 0			
	274	1	3
,, Entrance Fees (14)	14	14	0
,, Composition Fees (4)	31	10	10
,, Contributions towards the cost of Illustrations for Vol. XVII	22	15	0
,, The Trustees of the late Sir Wm. Bowman	50	0	0
,, Messrs. Churchill, Sale of 'Transactions'	43	13	0
,, Dividends:			
Ramsgate Corporation 3 per cent. Stock £7 0 3			
East India Railway B Annuities 17 18 4			
	24	18	7
	£539	1	2

Investments:
£282 6*s.* 8*d.* Ramsgate Corporation 3 per cent. Stock.
£20 East India Railway B Annuities.

(Signed) GEORGE COWELL, *Treasurer.*

June 22nd, 1898.

Payments.

1897–8.	£	s.	d.
By Bankers' Charges	0	7	2
,, Insurance	0	12	6
,, Printing Vol. XVII of 'Transactions,' &c.	148	6	0
,, Illustrations to Vol. XVII:			
Bale & Co. £47 10 0			
Lapidge 2 10 0	50	0	0
,, Reporting	17	17	0
,, Copies of Report of Sub-Committee on Enucleation	4	12	0
,, Library	40	0	0
,, Rent	80	0	0
,, Brass Name-plate	1	1	0
,, Sub-Librarian and Refreshments at Meetings	19	17	0
,, Purchase of £80 19*s.* 7*d.* Ramsgate Corporation 3 per cent. Stock	84	8	5
,, Secretaries' Petty Cash and Postages, and Hire of Lantern and Screen	3	15	3
,, Balance at Bankers, June 24th, 1898	88	4	10
	£539	1	2

Examined, compared with vouchers, and found correct.

(Signed) { SYDNEY STEPHENSON, ARNOLD LAWSON. } *Auditors.*

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